INPUT

About INPUT

INPUT provides planning information, analysis, and recommendations to managers and executives in the information processing industries. Through market research, technology forecasting, and competitive analysis, INPUT supports client management in making informed decisions.

Continuous-information advisory services, proprietary research/consulting, merger/acquisition assistance, and multiclient studies are provided to users and vendors of information systems and services (software, processing services, turnkey systems, systems integration, professional services, communications, systems/software maintenance and support).

Many of INPUT's professional staff members have more than 20 years' experience in their areas of specialization. Most have held senior management positions in operations, marketing, or planning. This expertise enables INPUT to supply practical solutions to complex business problems.

Formed as a privately held corporation in 1974, INPUT has become a leading international research and consulting firm. Clients include more than 100 of the world's largest and most technically advanced companies.

INPUT OFFICES

North America

Headquarters
1280 Villa Street
Mountain View, CA 94041-1194
(415) 961-3300
Telex 171407 Fax (415) 961-3966

New York
959 Route 46 East, Suite 201
Parsippany, NJ 07054
(201) 299-6999
Telex 134630 Fax (201) 263-8341

Washington, D.C.
1953 Gallows Road, Suite 560
Vienna, VA 22182
(703) 847-6870 Fax (703) 847-6872

International

Europe
Piccadilly House
33/37 Regent Street
London SW1Y 4NF, England
(01) 493-9335
Telex 27113 Fax (01) 629-0179

Paris
52, boulevard de Sébastopol
75003 Paris, France
(33-1) 42 77 42 77 Fax (33-1) 42 77 85 82

Tokyo
Saida Building
4-6, Kanda Sakuma-cho
Chiyoda-ku, Tokyo 101, Japan
(03) 864-0531 Fax (03) 864-4114

0007

NOVEMBER 1989

U.S. MARKET FOR UNIX

1989-1994

MPRD
1989
C.2

AUTHOR
U.S. MARKET FOR UNIX
TITLE
1989-1994

DATE LOANED | BORROWER'S NAME

BRO DART CAT No 23-108 PRINTED IN U. S. A.

INPUT®

1280 Villa Street, Mountain View, California 94041-1194 (415) 961-3300

Published by
INPUT
1280 Villa Street
Mountain View, CA 94041-1194
U.S.A.

Market Analysis Program (MAP)

U.S. Market for UNIX, 1989-1994

Copyright ©1989 by INPUT. All rights reserved.
Printed in the United States of America.
No part of this publication may be reproduced or distributed in any form or by any means, or stored in a data base or retrieval system, without the prior written permission of the publisher.

MPRD • 372 • 1989

Abstract

This report analyzes the market for the UNIX operating system between 1989 and 1994, with emphasis on the U.S. Data includes the penetration of UNIX into the mainframe, minicomputer, and personal computer/ workstation markets.

The report presents anad analyzes the key issues, user needs, vendor strategies, and industry consortia serving the UNIX market. Graphics-based user interfaces, software development environments, and related areas such as fault-tolerant and real-time computing are discussed. A discussion of UNIX strategies of leading hardware and software vendors is included. The report identifies business and market opportunities and provides recommendations to vendors and users of UNIX.

The report contains 132 pages and 116 exhibits and is part of INPUT's 1989 Market Analysis Program (MAP).

© 1989 by INPUT. Reproduction Prohibited.

Digitized by the Internet Archive
in 2017 with funding from
Peter Cunningham

https://archive.org/details/usmarketforunix13722unse

Table of Contents

I Introduction 1

A. Purpose of the Report 1
B. Scope and Organization 1
C. Report Methodology 2
D. Research Methodology 3
1. Vendor Interviews 3
2. INPUT Estimates of Vendor Revenue 5
3. Delivery Mode Classifications 5
4. User Expenditures vs. Vendor Revenues 5
5. Forecast Information 6
E. Economic Assumptions 6

II Executive Overview 9

A. UNIX Operating System Market 9
1. UNIX Market 9
2. UNIX Applications 10
B. UNIX Lobbying Groups 10
C. UNIX Strategies of Leading Vendors 12
1. UNIX Strategies of Leading Hardware Manufacturers 12
2. UNIX Strategies of Leading System Software Vendors 14
D. Related UNIX Environments 14
1. Other UNIX Operating System Environments 14
2. Other UNIX System Software Products 15
E. User and Software Vendor Requirements 15
1. User Requirements 15
2. Software Vendor Requirements 16
F. Conclusions and Opportunities 16
1. Conclusions 16
2. Advantages and Disadvantages of UNIX 17
3. Vendor Opportunities 18
4. User Opportunities 20

© 1989 by INPUT. Reproduction Prohibited.

Table of Contents (Continued)

II

G. Recommendations 20
1. Recommendations to UNIX Vendors 20
2. Recommendations to UNIX Users 21

III UNIX Market Analysis 23

A. The Computer Market 23
1. Market Model 23
2. Expanded Market Model 24
3. Evolution of UNIX 27
4. Market Segments 29
B. UNIX Operating System Market 29
1. Size of the U.S. Operating System Market 29
2. Size of the Overall U.S. Market for UNIX 30
3. Size of the U.S. Mainframe Market for UNIX 32
4. Size of the U.S. Minicomputer Market for UNIX 36
5. Size of the U.S. Workstation/Personal Computer Market for UNIX 39
C. Primary User Applications in the UNIX Market 44
D. UNIX in Western Europe and Japan 45
1. UNIX in Western Europe 45
2. UNIX in Japan 46
E. UNIX-Related Mergers and Acquisitions 49
F. UNIX Software Distribution 50

IV UNIX Operating System Environment 53

A. Introduction 53
B. Organizations Focusing on UNIX System Software 54
1. Primary UNIX Industry Consortia 54
2. Secondary UNIX Industry Consortia 63
C. Organizations Focusing on UNIX Telecommunications 67
D. Organizations Focusing on RISC-Based Processor Architectures 71
E. Summary of UNIX Lobbying Organizations 77
F. Role of RISC-Based Architectures in UNIX 79
G. UNIX Strategies of Leading Hardware Manufacturers 81
1. Introduction 81
2. Mainframe Vendors 82
a. IBM 82
b. National Advanced Systems 84
c. Amdahl 84

© 1989 by INPUT. Reproduction Prohibited.

Table of Contents (Continued)

IV

3. Mid-Range Systems Vendors 85
   a. Hewlett-Packard 85
   b. The Ultimate Corporation 87
   c. Nixdorf 88
   d. Unisys 88
   e. Digital Equipment 90
4. Personal Computers/Workstations 91
   a. Sun Microsystems 91
   b. IBM 93
   c. Apple 94
5. Summary of Hardware Vendors' UNIX Strategies 95

H. UNIX Strategies of Leading System Software Vendors 96
1. Introduction 96
2. UNIX Strategies 96
   a. AT&T 96
   b. Microsoft 97
   c. The Santa Cruz Operation 98
   d. Mt. Xinu 99

V Related UNIX Environments 101

A. Other UNIX-Based Operating Systems 101
1. Secure Versions of UNIX 101
2. Fault-Tolerant Versions of UNIX 102
3. Real-Time Versions of UNIX 103

B. Other UNIX System Software Products 104
1. Graphical User Interface (GUI) 104
2. Relational Data Base Management Systems (RDBMSs) 109

C. UNIX Application Software Products 111
D. Turnkey UNIX-Based System Solutions 114

VI User and Software Vendor Requirements 115

A. UNIX-Related User Requirements 115
1. Why Users Adopted UNIX 115
2. Current UNIX Usage 116
3. Users' Reasons for Dropping UNIX 117
4. Non-Users' Reasons for Not Trying UNIX 117

B. UNIX-Related Software Vendor Requirements 118
1. Why Software Vendors Chose UNIX 118
2. Software Vendors' Development Environment 119

© 1989 by INPUT. Reproduction Prohibited.

Table of Contents (Continued)

VI Conclusions, Opportunities, and Recommendations 121

A. Conclusions 121
1. Conclusions about UNIX 121
2. Advantages of Using UNIX 122
3. Disadvantages of Using UNIX 123
4. Barriers to Widespread Acceptance of UNIX 124
B. Vendor Opportunities in UNIX 125
C. User Opportunities in UNIX 126
D. Recommendations to UNIX Software Vendors 128
E. Recommendations to UNIX Users 130

© 1989 by INPUT. Reproduction Prohibited.

Exhibits

I

-1 INPUT Research Methodology 4
-2 GNP Nominal Growth Rate Assumptions 6

II

-1 UNIX Value of Total U.S. Operating System Market, 1989 10
-2 UNIX Market by Primary Application, 1989 11
-3 Relative Position of UNIX Industry Consortia 11
-4 Summary of Hardware Vendors' UNIX Strategies 13
-5 Conclusions 16
-6 Advantages of Using UNIX 17
-7 Disadvantages of Using UNIX 18
-8 Vendor Opportunities in UNIX 19
-9 User Opportunities in UNIX 20
-10 Recommendations to Vendors 21
-11 Recommendations to Users 21

III

-1 Key Components of a Computer System 24
-2 Standard Software Components of a UNIX-Based System 25
-3 Key System Software Segments in UNIX Market 26
-4 Matrix of UNIX Computing Environments 27
-5 The Evolution of UNIX 28
-6 Hardware Segment Definitions 29
-7 U.S. Systems Control Software Market, 1988-1994 30
-8 U.S. Systems Control Software Market by Hardware Platform Segment, 1989-1994 31
-9 UNIX System Software Market, 1989 31
-10 UNIX Proportion of Total U.S. Operating System Market as of 1989 33
-11 U.S. Mainframe Systems Control Software Market 33
-12 UNIX Share of U.S. Mainframe Systems Control Software Market, 1989 34
-13 Leading Mainframe Vendors Offering UNIX 35

© 1989 by INPUT. Reproduction Prohibited.

Exhibits (Continued)

III

-14	UNIX Share of U.S. Mainframe Shipments, 1994	35
-15	U.S. Minicomputer Operating System Market Through 1989	36
-16	UNIX Share of Annual U.S. Minicomputer Shipments, 1989	37
-17	Minicomputer Vendors Offering UNIX	38
-18	Forecast UNIX Share of Annual U.S. Minicomputer Shipments, 1994	39
-19	U.S. Workstation/Personal Computer Operating System Market	40
-20	Workstation Vendors Offering UNIX	40
-21	Personal Computer Equipment Vendors Offering UNIX	41
-22	Personal Computer Software Vendors Offering UNIX	42
-23	UNIX Share of Annual U.S. Workstation/Personal Computer Shipments, 1989	43
-24	UNIX Share of Annual U.S. Workstation/Personal Computer Shipments, 1994	43
-25	UNIX Market by Primary Application, 1989	44
-26	UNIX in Western Europe	45
-27	UNIX in Western Europe	47
-28	UNIX Sales Activities in Japan	48
-29	UNIX Organizations in Japan	49
-30	Mergers and Acquisitions in the UNIX Market	49
-31	U.S.-Based Distributors of "Shrink-Wrapped" UNIX Software Products	51

IV

-1	UNIX Lobbying Organization Profile Format	53
-2	Profile: UNIX International (UI)	55
-3	UNIX International Members	56
-4	Profile: Open Software Foundation (OSF)	57
-5	Open Software Foundation Members (As of June 1989)	58
-6	OSF vs. UI Differences	59
-7	Profile: X/Open Ltd.	60
-8	Current X/Open Standardization Efforts	61
-9	Comparison of Standards for Open Software Environments	62
-10	Profile: Open Desktop Group	64
-11	Organizations/Vendors Endorsing "Open Desktop" (at Uniforum; San Francisco, CA; March 1989)	65
-12	Profile: Object Management Group	66
-13	Profile: Strategies for Open Systems	67

© 1989 by INPUT. Reproduction Prohibited.

Exhibits (Continued)

IV

-14	Profile: Open Token Foundation	68
-15	Profile: Corporation for Open Systems (COS)	69
-16	Profile: OSI/Network Management Forum	71
-17	UNIX Organizations Focusing on RISC Architecture	72
-18	Profile: SPARC International (SI)	72
-19	Profile: 88open Consortium Ltd.	74
-20	88open Consortium Ltd. Members	75
-21	Profile: System Performance Evaluation Cooperative (SPEC)	76
-22	Relative Position of UNIX Industry Consortia	77
-23	Leading Vendors of RISC-Based Processors	79
-24	Other Important Vendors of RISC-Based Processors	80
-25	RISC Technology Licensing by Semiconductor Manufacturers	81
-26	UNIX Strategy: IBM (Mainframe)	82
-27	UNIX Strategy: IBM (Mainframe)	83
-28	UNIX Strategy: National Advanced Systems (NAS)	84
-29	UNIX Strategy: Amdahl Corporation	85
-30	UNIX Strategy: Hewlett-Packard (Mid-range Systems)	86
-31	UNIX Strategy: Hewlett-Packard (Mid-range Systems)	87
-32	UNIX Strategy: The Ultimate Corporation (Mid-range Systems)	88
-33	UNIX Strategy: Nixdorf Computer Corporation (Mid-range Systems)	89
-34	UNIX Strategy: Unisys (Mid-range Systems)	89
-35	UNIX Strategy: Digital Equipment (Mid-range Systems)	90
-36	UNIX Strategy: Digital Equipment (Mid-range Systems)	91
-37	UNIX Strategy: Sun Microsystems	92
-38	Sun Microsystems' "Five Phase" Plan for UNIX Workstations	93
-39	UNIX Strategy: IBM (Personal Computers)	93
-40	UNIX Strategy: Apple Computer	95
-41	Summary of Hardware Vendors' UNIX Strategies	95
-42	UNIX Strategy: AT&T	96
-43	UNIX Strategy: Microsoft Corporation	97
-44	UNIX Strategy: The Santa Cruz Operation	98
-45	UNIX Strategy: Mt. Xinu	99

© 1989 by INPUT. Reproduction Prohibited.

Exhibits (Continued)

V

-1	New UNIX-Derivative Operating Systems	102
-2	Vendors of Fault-Tolerant UNIX Software	103
-3	Vendors of UNIX-Based Real-Time Computer Systems	104
-4	A Sample of UNIX-Based Graphical User Interface (GUI) Products from Hardware Vendors	105
-5	A Sample of UNIX-Based Graphical User Interface Products from Third-Party Software Vendors	106
-6	Vendors Exhibiting at XHibition '89 (June 1989; San Jose, CA)	107
-7	Applications at XHibition '89 Integrating X/Window User Interface	108
-8	Open Look vs. OSF/Motif at XHibition '89 (June 1989; San Jose, CA)	109
-9	Leading Vendors of UNIX-Based RDBMS Software	110
-10	Leading Vendors of UNIX-Based Application Development Tools	111
-11	Number of UNIX-Based Horizontal Application Software Packages	112
-12	Number of UNIX-Based Vertical Application Software Packages	113
-13	UNIX-Based Image Processing Systems	114

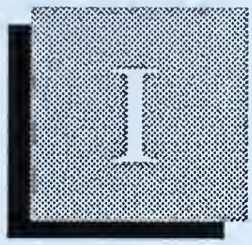
VI

-1	Users: How We Selected UNIX	115
-2	Users: Current Use of UNIX	116
-3	Former Users: Why We Dropped UNIX	117
-4	Non-Users: Why Not UNIX?	118
-5	Software Vendors: Why We Chose UNIX	119
-6	Software Vendors: UNIX Development Environment	119

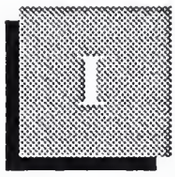
VII

-1	Conclusions	122
-2	Advantages of Using UNIX	123
-3	Disadvantages of Using UNIX	124
-4	Barriers to Widespread Acceptance of UNIX	125
-5	Vendor Opportunities in UNIX	127
-6	User Opportunities in UNIX	127
-7	Recommendations to Vendors	128
-8	Recommendations to Users	130

© 1989 by INPUT. Reproduction Prohibited.



Introduction



Introduction

This report on UNIX is one of four reports for 1989 in INPUT's Market Analysis Program (MAP). The topics, selected in response to Market Analysis Program client requests, include:

- Personal Computer Software Products
- Acquisitions in the IS Industry
- Network Management

Readers are encouraged to read the three companion reports in order to broaden their knowledge about the growing Information Services industry.

A

Purpose of the Report

The report provides readers with information and insights that will allow them to:

- Review the forces that are shaping the market
- Identify new markets and possible product opportunities
- Identify competing products
- Understand the political environment in the UNIX market
- Prioritize investment dollars

B

Scope and Organization

The report focuses on the UNIX market in the U.S., since data is shown only for the U.S. market. For comparison, select UNIX activities in Japan and Western Europe are presented.

The *UNIX Software Market, 1989-1994* report is organized as follows:

- Chapter II, the Executive Summary, provides an overview of the report and highlights the most important information.

© 1989 by INPUT. Reproduction Prohibited.

- The UNIX market is discussed in Chapter III.
- Chapter IV analyzes the UNIX operating system environment, including industry consortia and the strategies of leading hardware and software vendors.
- Related UNIX environments, such as graphical user interfaces and relational data base management software, are discussed in Chapter V.
- Chapter VI evaluates software developer and UNIX user requirements.
- Conclusions, market opportunities, and recommendations to vendors and users are presented in Chapter VII.

C Report Methodology

First, INPUT surveyed nearly 30 vendors of:

- UNIX-based application software
- Non-UNIX-based application software
- System software
- Software development tools
- Systems running on UNIX

Second, INPUT surveyed about 25 users and non-users of UNIX software covering a broad range of vertical markets and U.S. locations.

Next, INPUT representatives attended the following UNIX-related events:

- UniForum (February 1989; San Francisco, CA)
- Xhibition 89 (June 1989; San Jose, CA)
- Various press announcements and analysts' meetings held by leading hardware and software vendors in the UNIX market

Fourth, computer industry and non-computer industry periodicals and vendor promotional literature provided background information.

Fifth, data from INPUT's proprietary data base of systems and application software vendors was tailored to the UNIX market. The research methodology behind INPUT's data base is discussed in the next section.

© 1989 by INPUT. Reproduction Prohibited.

D

Research Methodology

1. Vendor Interviews

INPUT methodology for data collection, analysis, and forecasting is depicted in Exhibit I-1. During the second and third quarters of 1989, INPUT conducted in-depth interviews with more than 900 information services vendors, including nearly all of the largest 250 firms. Of this group of 250 vendors, the smallest represented about $20 million in 1988 revenues.

Of the nearly 950 companies, revenues of the smaller 650 or so companies ranged from $270,000 to $20 million. Collectively, revenues from all the firms surveyed represented 70% of total information services industry revenues.

In the case of the few very large vendors that did not respond to the survey, INPUT estimated overall vendor revenues from its own contacts and secondary sources. This estimation process was completed for all firms with annual revenues greater than $10 million. For firms with revenues below $10 million (and not specifically covered in the survey), INPUT created a model based on the number of such firms identified in each delivery mode and their expected average annual revenues.

The sum of these surveys and estimates produced the initial vendor revenue estimates for 1988. From this figure, INPUT subtracted revenues identified as:

- Non-information services
- International (non-U.S.)
- Captive (within the organization)
- Due to acquisitions (used only to calculate growth rate)

The revenue data in this report include only the following:

- U.S. revenues. Revenues from systems and application software are included in this report. All foreign revenues are excluded.

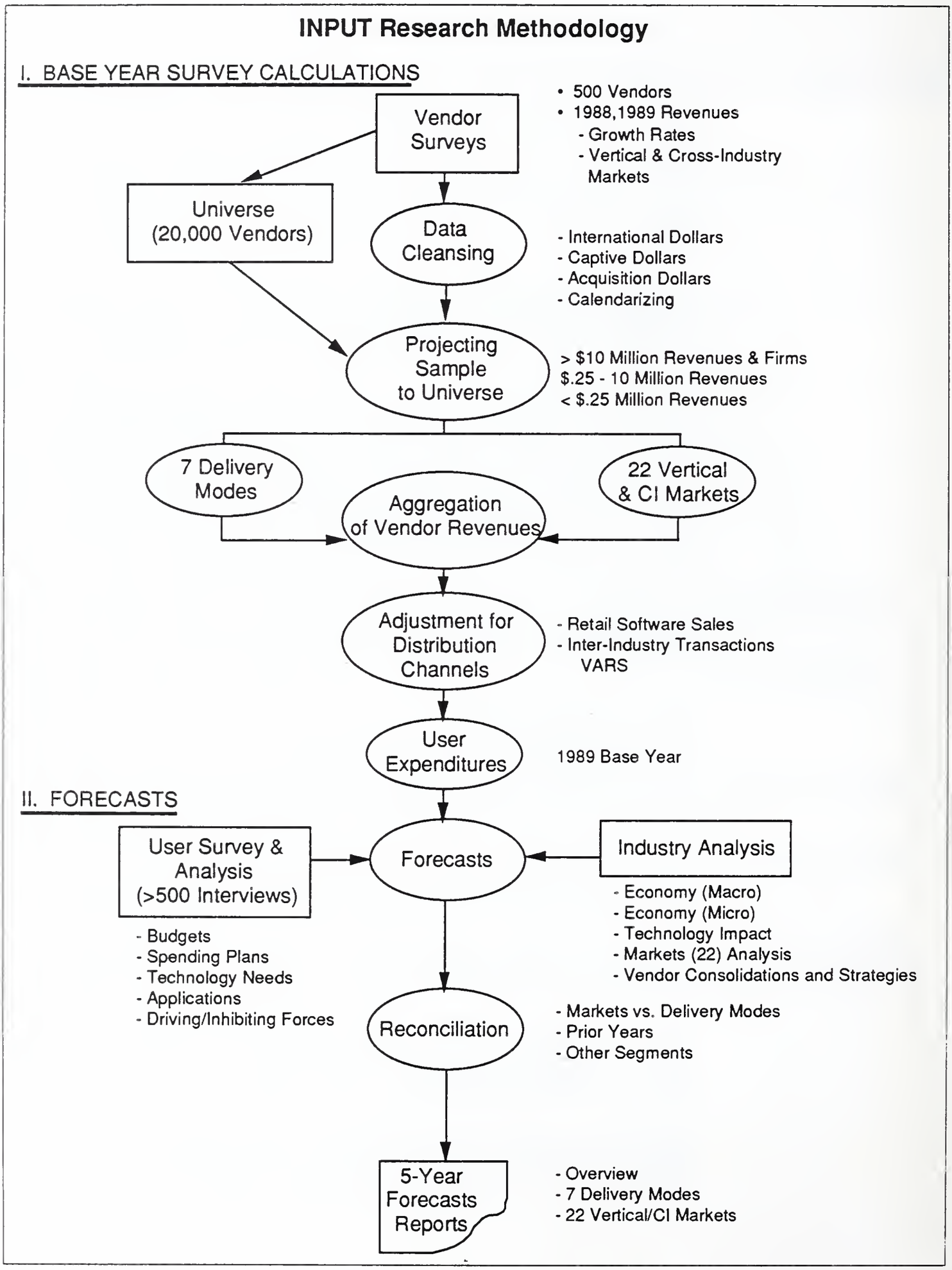
- Information services revenues. Revenues from embedded systems or turnkey systems are excluded.

- Noncaptive revenues. Only revenues available to all vendors in a competitive marketplace are included. Revenues derived from sales to partners or affiliated organizations are excluded.

- Calendar year revenues. Approximately 30% of vendors surveyed have fiscal years that do not coincide with calendar years. Revenues of these companies have been adjusted to a calendar year basis for consistency.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT I-1



© 1989 by INPUT. Reproduction Prohibited.

- Rounding of revenues. For large vendors, revenues are rounded to the nearest $5 million to normalize the lesser degree of accuracy when data was estimated by INPUT.

- Margin of error. Revenues reported by private companies, subsidiaries of large corporations, computer manufacturers, and international CPA firms are generally subject to a wider margin of error than reported revenues of other companies.

2. INPUT Estimates of Vendor Revenue

Companies that are not exclusively involved in information services are identified as follows:

- If a division or its subsidiary that markets all information services for a company is generally known by its own name, then it is identified by that name rather than the parent company's name. An example is Boeing Computer Services Company, a division of the aircraft manufacturer The Boeing Company.

- If more than one division or subsidiary markets information services, the information is included in, and identified by, the parent company's name. An example is Control Data Corporation.

- Organizations are reported according to their legal status as of the date of publication.

3. Delivery Mode Classifications

Companies have been classified according to the single delivery mode of service from which they derive the largest portion of their U.S., non-captive information services revenues.

Total base year revenues (1988) are then summed into six delivery modes and twenty-two vertical- and cross-industry segments for closer analysis and five-year projections.

4. User Expenditures vs. Vendor Revenues

INPUT considers industry revenue to include two separate subsets of data: (1) User expenditures, which equate with market size; and (2) vendor revenues. For certain delivery modes, vendor revenues and user expenditures are fairly close. However, many microcomputer software products, for example, are marketed through indirect distribution channels, such as retail stores, OEMs, and VARs, where conversion factors must be applied to accurately determine the total market size based on vendor revenues. In addition, some software is sold by vendors into other information services sectors, such as processing services or network

© 1989 by INPUT. Reproduction Prohibited.

services. This software could be used in these other IS sectors' data centers and never be passed directly to the end user. INPUT deletes such intraindustry transactions from its user expenditure market data.

The following table shows the various conversion factors used by INPUT to convert vendor revenues to end user expenditures (market size) for each delivery mode:

• Application software	1.18
• Systems software	1.10
• Turnkey systems	0.99
• Systems integration	0.99
• Professional services	0.99
• Network services	0.99
• Processing services	0.99

5. Forecast Information

From the 1989 user expenditures identified in this report, INPUT projects five-year market growth rates for the delivery mode and vertical/cross-industry market, based on its own analysis of technology, vendor activity, driving and inhibiting forces affecting each market, and economic outlook.

E

Economic Assumptions

The inflation rates used in the forecast data base are shown in Exhibit I-2.

EXHIBIT I-2

GNP Nominal Growth Rate Assumptions (Percent)

	1988A	1989E	1990E	1991E	1992E	1993E	1994E
Real GNP	4.4	2.8	2.5	2.3	2.0	2.0	2.0
*GNP Deflator	3.0	4.8	5.2	5.5	5.0	4.5	4.5
Nominal GNP	7.4	7.6	7.7	7.8	7.0	6.5	6.5

*Year-to-Year Comparisons

A = Actual
E = Estimate

Source: INPUT, based on data from U.S. Bureau of Labor Statistics

© 1989 by INPUT. Reproduction Prohibited.

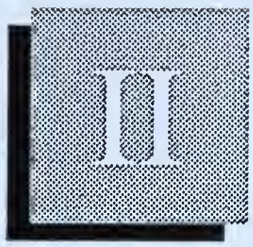
For a complete view of the information services market, readers are encouraged to review related INPUT reports. To gain a "bottoms up" view of the information services industry, we recommend that readers look at the following four annual market reports:

- *U.S. Professional Services Market, 1988-1993*
- *U.S. Processing/Network Services Market, 1988-1993*
- *U.S. Software Products Market, 1988-1993*
- *U.S. Turnkey Systems Market, 1988-1993*

INPUT welcomes your comments, thoughts, and suggestions about this report.

© 1989 by INPUT. Reproduction Prohibited.

© 1989 by INPUT. Reproduction Prohibited.



Executive Overview

II

Executive Overview

This chapter, which summarizes INPUT's findings on UNIX, is divided into:

- UNIX operating systems market
- UNIX lobbying groups
- UNIX strategies of leading vendors
- Related UNIX environments
- User and software vendor requirements
- Conclusions and opportunities
- Recommendations

A UNIX Operating System Market

1. UNIX Market

As of late 1989, UNIX represented around 14% of the $5.0 billion U.S. market for operating system software (shown in Exhibit II-1). It is more meaningful to discuss the share in 1989 of UNIX in each of the major market segments:

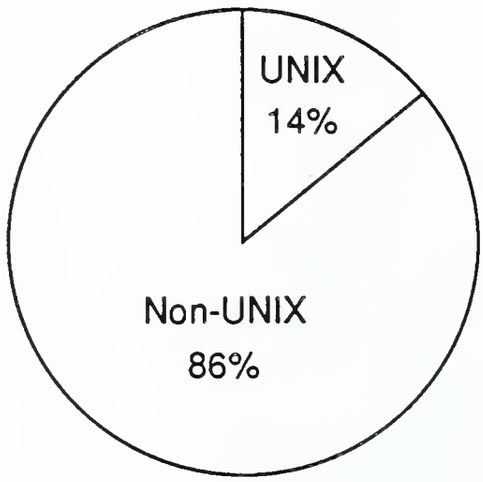
- Mainframes: 13% of $2.6 billion market
- Minicomputers: 36% of $1.8 billion market
- Workstations/Personal Computers: 19% of $1.2 billion market

The number of vendors selling AT&T UNIX or proprietary derivative operating systems varies by platform. Two mainframe vendors, Amdahl and IBM (expected to ship AIX in 1Q/1990), offer UNIX or derivative software. In the minicomputer segment, 25 hardware vendors offer some form of UNIX. Nine software vendors and 22 hardware vendors of personal computers and workstations offer UNIX or proprietary products based on UNIX.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT II-1

UNIX Value of Total U.S. Operating System Market, 1989



Total U.S. Operating System Software Market (1989) = $5.7 Billion

2. UNIX Applications

UNIX was first used in engineering/scientific/technical applications. To date, these applications represent nearly 80% of primary UNIX usage, indicated in Exhibit II-2. Commercial applications, which account for the remaining 20%, include:

- Accounting
- Decision support
- Industry-specific applications
- Inventory control
- Office automation
- Payroll
- Personnel

B

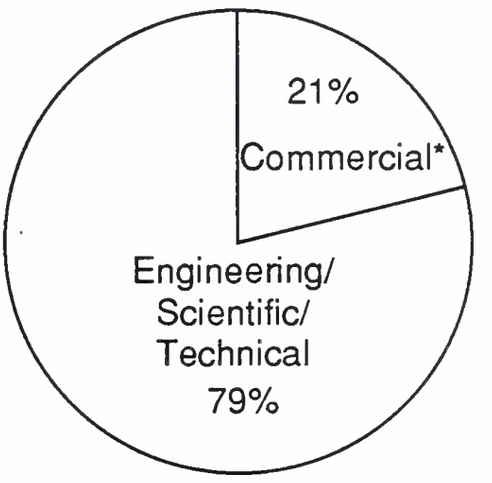
UNIX Lobbying Groups

The report contains profiles of 12 lobbying organizations which influence the future direction of UNIX, telecommunication standards, and RISC-based hardware architectures. As shown in Exhibit II-3, the charters for the following organizations provide the greatest operating breadth (and influence):

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT II-2

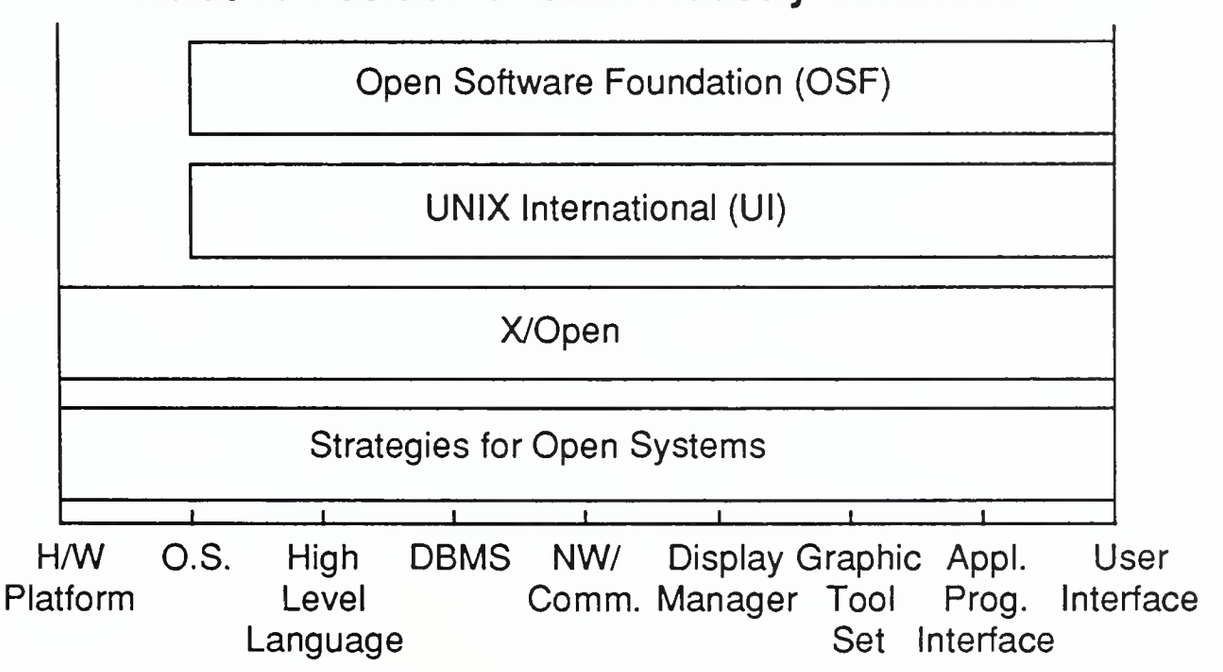
UNIX Market by Primary Application, 1989



* Includes: Office automation; accounting; inventory control; personnel; payroll; decision support; purchasing; industry-specific applications

EXHIBIT II-3

Relative Position of UNIX Industry Consortia



© 1989 by INPUT. Reproduction Prohibited.

- X/Open
- Strategies for Open Systems
- 88open
- UNIX International (UI)
- Open Software Foundation (OSF)

At this time, it appears that X/Open and UNIX International are more influential than other UNIX organizations. X/Open is using its position to help mend fences between UI and OSF. UI's strong technical expertise from its broad membership has created more momentum than OSF. Industry "scuttlebut" indicates some OSF vendors are now writing software compliant with the UI standard.

Further, IBM's role as a UNIX lobbyist should not be discounted. While it has announced AIX, a proprietary version of UNIX, IBM would most gain by promoting its proprietary System Application Architecture (SAA). From a somewhat Machiavellian viewpoint, it could be argued that OSF was IBM's contribution to UNIX market confusion. IBM would then have more time to develop relationships with application software vendors for supporting SAA.

OSF will remain. In the short term, various new products will comply with OSF standards. However, over the longer term, it is believed that OSF and UI will converge, with OSF giving up slightly more than UI to arrive at a compromise.

C

UNIX Strategies of Leading Vendors

1. UNIX Strategies of Leading Hardware Manufacturers

Question: "Name a dog, a frog, and a memory hog?"
Answer: Huckleberry Hound; Kermit; and UNIX

Question: "What operating system has been embraced by nearly every major hardware manufacturer?"
Answer: UNIX

Whatever UNIX' relative strengths and weaknesses, it is becoming a major operating system. UNIX is the primary operating system for Sun, Unisys mid-range commercial systems, Hewlett-Packard technical computers, and Amdahl, indicated in Exhibit II-4. Since UNIX is an important differentiator, these firms have nurtured third-party software vendors and have developed "real" products based on UNIX.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT II-4

Summary of Hardware Vendors' UNIX Strategies

Vendors	UNIX Position		Target Users				Target Markets				
	Primary	Secondary	Software Devel.	Tech.	Commercial	SI	Education	Manufacturing	Government	Bank/Finance	Other
Sun	X		X	X	X	X	X	X	X	X	
DEC		X	X			X	X	X	X	X	X
Unisys	X(1)										X
IBM Mainframe		X			X	X	X	X	X	X	X
Amdahl	X								X	X	X
HP		(2)			X			X	X	X	X
Nixdorf		(1)						X			X
IBM Microcomputers		X					X	X	X	X	X
Apple		X				X	X		X		
IBM Mid-range		X(2)			X	X		X	X	X	X

(1) For mid-range processors
(2) Primary operating system in technical environments; secondary operating system in commercial environments

IBM's possible actions, detailed in the report, include offering UNIX support. The relevant questions for IBM in UNIX are:

- "How broad will that support be?"
- "Will IBM include any proprietary products in its UNIX scheme?"

The report offers additional information about IBM's potential UNIX strategy.

© 1989 by INPUT. Reproduction Prohibited.

2. UNIX Strategies of Leading System Software Vendors

Software strategies for AT&T, Microsoft, The Santa Cruz Operation, and Mt. Xinu are evaluated. AT&T will most likely add enhancements to UNIX, making it suitable for a wider range of operating environments. Such enhancements may include:

- Transaction processing
- Fault tolerance
- Multiprocessor environments
- Real time
- Support for foreign languages

Microsoft will likely leverage its distribution and support capabilities, using its 20% stake in The Santa Cruz Operation to ensure a steady stream of products.

Santa Cruz Operation may take a multi-pronged attack on UNIX. It may follow the dictates of AT&T, continue to build its Open Desktop environment, or use both approaches to promote UNIX.

Mt. Xinu will focus on the new multiprocessor version of UNIX, dubbed "Mach" and developed with Carnegie Mellon University (Pittsburgh, PA). The Company will also market and support new CMU products including Camelot (transaction processing support) and Andrew (tool kit and file system).

D
Related UNIX Environments

1. Other UNIX Operating System Environments

The UNIX market is by no means monolithic. Instead, this market has taken a mix-and- match approach to system software. Other UNIX operating system environments include:

- Derivative operating systems
- Fault-tolerant versions
- Real-time versions

Proprietary versions of UNIX incorporate support for multiprocessing environments, improved system security, and real-time and fault-tolerant computing. Real-time computing is a relatively active area, with eight hardware and at least three software vendors supporting this computing environment.

These areas hold great promise for UNIX. As UNIX adds system features, it will be used in more operating environments. Since AT&T is likely to incorporate some system enhancements, these vendors are well positioned for future UNIX market growth.

© 1989 by INPUT. Reproduction Prohibited.

2. Other UNIX System Software Products

Other UNIX software products include:

- Graphical user interface (GUI)
- Relational data base management system (RDBMS) software
- Application development tools
- Cross-industry sector software
- Vertical market application software

These various UNIX product areas are listed only to demonstrate that UNIX has not simplified the computer industry. In fact, it is argued that UNIX greatly complicates the overall industry scheme. Every additional "standard" product has a tremendous multiplier effect on the industry. For example, having three GUIs, 8 RDBMSs, and 4 application development tools yields 96 possible combinations from which to select. Adding one new RDBMS yields 108 possibilities. Hardly simple to select or support!

E

User and Software Vendor Requirements

1. User Requirements

Users have had varied experiences with UNIX. Most users selected UNIX for one of two reasons:

- UNIX was part of a turnkey solution
- A visionary in their company selected UNIX

Current UNIX use, strongest in scientific/technical applications including software development, is spreading to commercial environments. Users are now running UNIX in the following commercial applications:

- Business management (generally a turnkey solution)
- Office automation
- Communications
- Education and training

As with other operating system environments, users require post-sale support and software updates. It has not been determined whether UNIX users are more or less demanding than users of other operating systems. However, their support needs must be met for vendors to be successful.

Users did not select UNIX due to the:

- Amount of system management required
- Required retraining of unsophisticated users
- Expense of conversion

© 1989 by INPUT. Reproduction Prohibited.

2. Software Vendor Requirements

Software vendors selected UNIX due mainly to its portability, followed by federal government contract requirements and customer requests.

While the "C" language is an excellent tool for software development, most vendors contacted by INPUT indicated they use a combination of "C" and procedural languages. Sections of code are written in one form or the other, then blended to produce the final product.

F

Conclusions and Opportunities

1. Conclusions

While promoting open standards, UNIX is not, in 1989, truly open. Too many approaches, each claiming to be "the" standard, exist. Application software vendors, whose support is necessary for the success of *any* market, must:

- Write two graphical user interfaces,
- Support two or three communication methodologies, and
- Support multiple application program interfaces.

As shown in Exhibit II-5, UNIX' greatest penetration is in minicomputers, while its best market opportunity is in personal computers/workstations. UNIX began in minicomputers; workstations widely use UNIX derivative operating systems; personal computers now have the power to support UNIX.

EXHIBIT II-5

Conclusions

- While promoting open standards, UNIX is not, in 1989, truly open
- UNIX strongest in minicomputers; fastest growth in PC/workstations
- Any graphical user interface will foster acceptance of UNIX
- More commercial applications are required for UNIX to be successful

© 1989 by INPUT. Reproduction Prohibited.

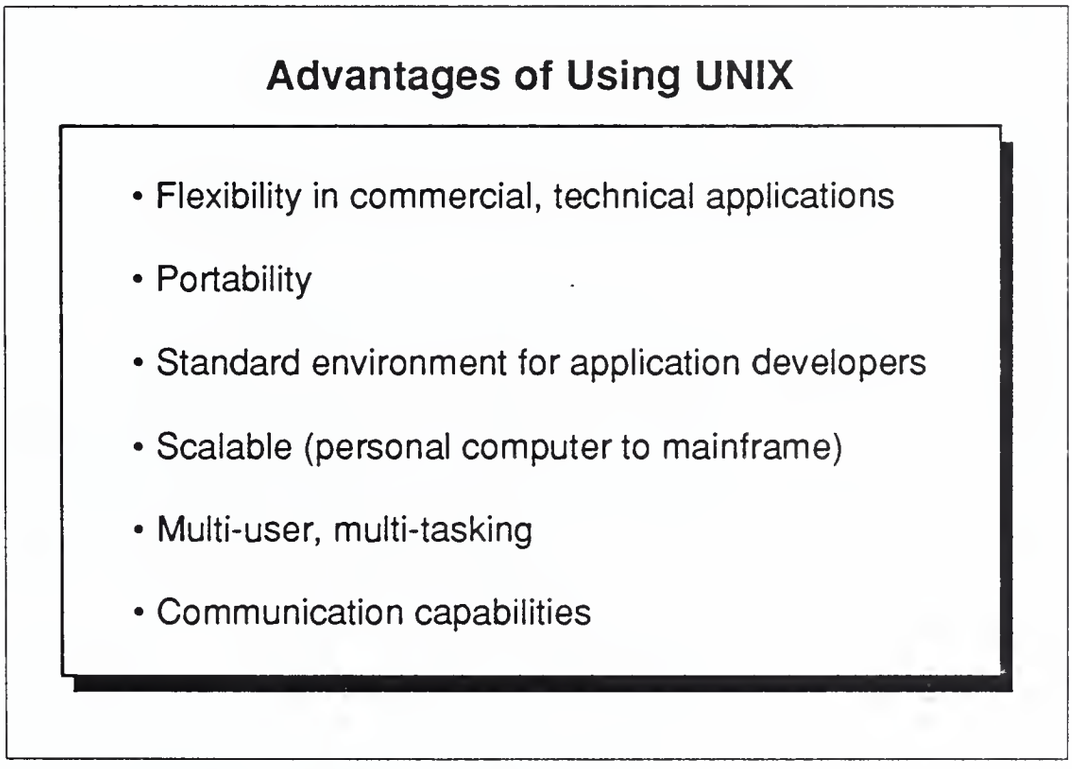
Apple Computer's successful graphical interface for the Macintosh is eating into other vendors' market shares. Standards or no, *any* graphical user interface will foster acceptance of UNIX. Given the unique UNIX command syntax, a user interface is highly desirable for new users or users of other operating systems converting to UNIX.

For UNIX to be truly successful, more off-the-shelf commercial application software must be sold. To do this requires the endorsement of UNIX by leading vendors of spreadsheets, word processing, and data base management software. Vertical market specialists, the value-added resellers (VARs), may now provide UNIX-based solutions and support. But UNIX must be made easier to install and support before its acceptance becomes widespread.

2. Advantages and Disadvantages of UNIX

Exhibits II-6 and II-7 list advantages and disadvantages of UNIX. The well-known advantages include portability, flexibility, scaleable architecture, and multi-user, multi-tasking, and network communication capabilities.

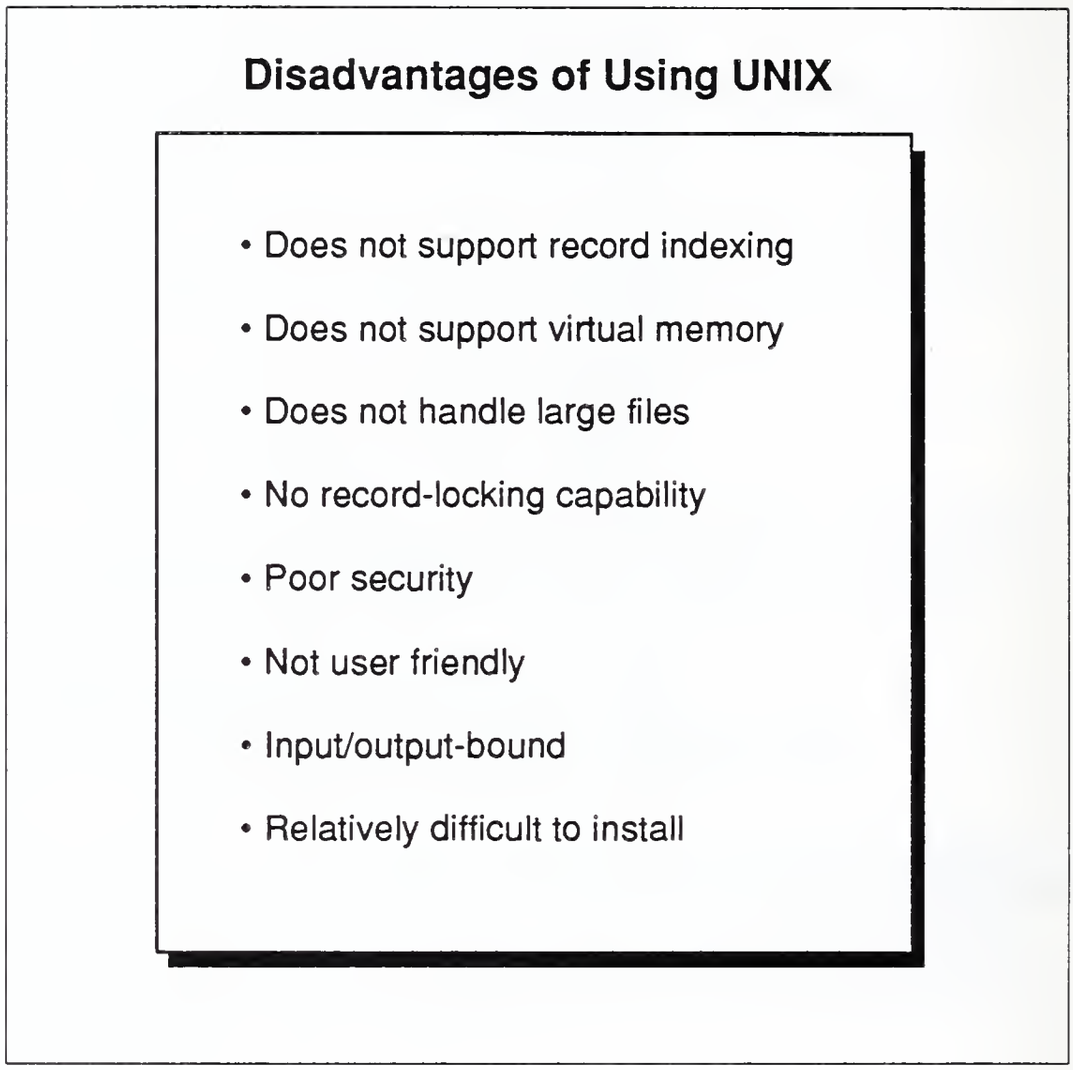
EXHIBIT II-6


Advantages of Using UNIX
• Flexibility in commercial, technical applications
• Portability
• Standard environment for application developers
• Scalable (personal computer to mainframe)
• Multi-user, multi-tasking
• Communication capabilities

Its main disadvantages include lack of support for large files, poor security, being input/output-bound (creating processing bottlenecks), not user friendly, and relatively difficult to install.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT II-7


Disadvantages of Using UNIX
• Does not support record indexing
• Does not support virtual memory
• Does not handle large files
• No record-locking capability
• Poor security
• Not user friendly
• Input/output-bound
• Relatively difficult to install

3. Vendor Opportunities

Since UNIX is a relatively young market, vendors have a number of opportunities (listed in Exhibit II-8). Vendors can concentrate on UNIX-based office system applications which effectively utilize UNIX' file server capabilities. Office system applications include executive information systems (EIS), office automation, electronic mail, text processing, and integrated functions.

In addition, vendors can offer:

- Personal productivity software (spreadsheets, easy-to-use RDBMSs, and integrated productivity software)
- Business cross-industry application software
- Business vertical market application software
- UNIX differentiators

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT II-8

Vendor Opportunities in UNIX

- Office systems (file servers)
  - EIS
  - OA
  - Text processing
- Business applications
  - Accounting
  - Human resources
  - Education and training
- Personal productivity software
  - Spreadsheet
  - Easy-to-use RDBMS
  - Integrated software (communications, WP, spreadsheet, calendar, telephone directory)
- Differentiators

Differentiators include developing UNIX versions for:

- Fault-tolerant computing
- Multiprocessor (hardware) environments
- Real-time and near-real-time applications
- Secure operating environments
- Communication-intensive applications

© 1989 by INPUT. Reproduction Prohibited.

4. User Opportunities

Users should investigate UNIX for applications with the requirements listed in Exhibit II-9. Applications which are multi-user, multi-tasking and/or communications-intensive are well suited for UNIX. Users should not try to "shoe horn" UNIX to fit applications where its weaknesses outnumber its strengths.

EXHIBIT II-9

User Opportunities in UNIX

- Multi-user, multi-tasking applications
- Communications-intensive applications
- Limited independence from hardware vendors

G Recommendations

1. Recommendations to UNIX Vendors

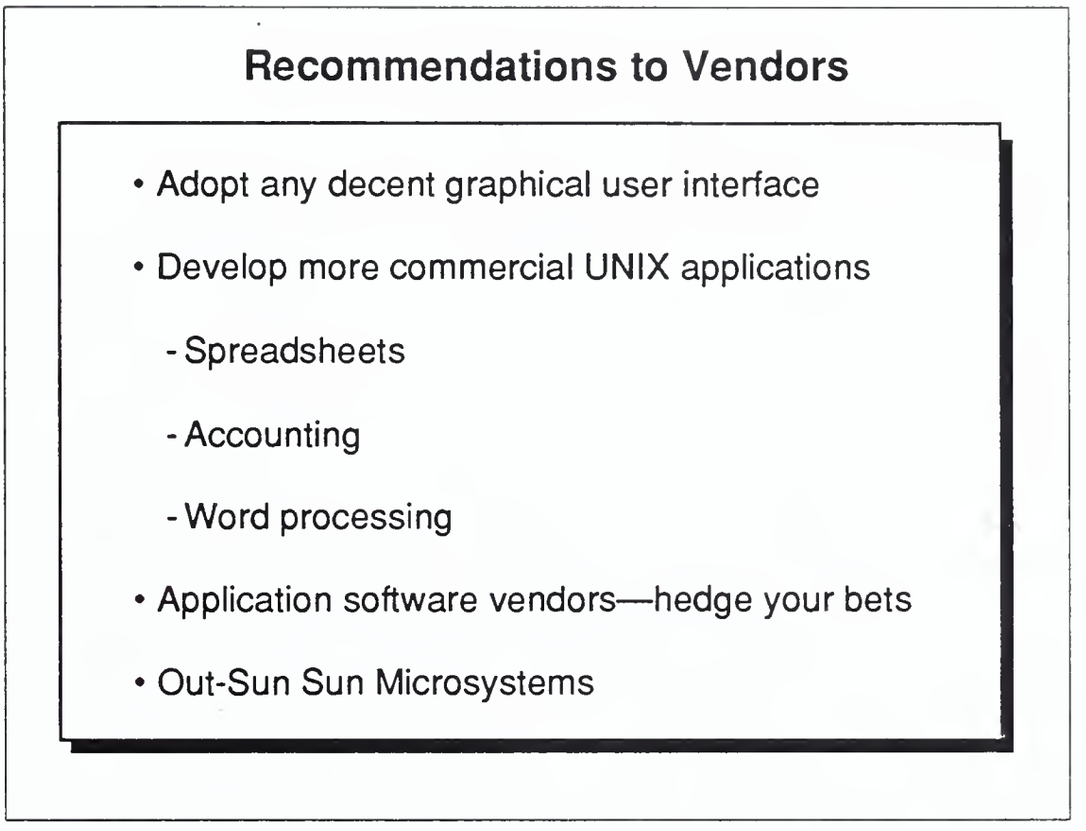
To address the weaknesses of UNIX and build on its strengths, INPUT makes the vendor recommendations shown in Exhibit II-10. Since the first two are self-explanatory, only the latter two recommendations will be discussed.

Application software vendors will have to hedge their bets. A forthcoming INPUT study on the personal computer software market indicates that 41% of leading PC application software vendors surveyed currently write for UNIX or XENIX operating systems. More than 50% of these vendors also write application software for DOS or Macintosh environments. The study also indicated that 86% of vendors surveyed are either now writing for UNIX, planning to write for UNIX, or examining the possibility of writing for UNIX in the next two years.

A timely vendor strategy would be to "out-Sun" Sun Microsystems—in other words, to offer a system which includes UNIX products which conform to government, IEEE, and ANSI standards. The system will contain no proprietary hooks and no product "improvements." While some question remains as to exactly which standard will become *the standard*, nevertheless a vendor could make a significant impact. Like Sun, make the migration to your product far easier than away from it. Unlike Sun, leave out the hooks and improvements.

© 1989 by INPUT. Reproduction Prohibited.

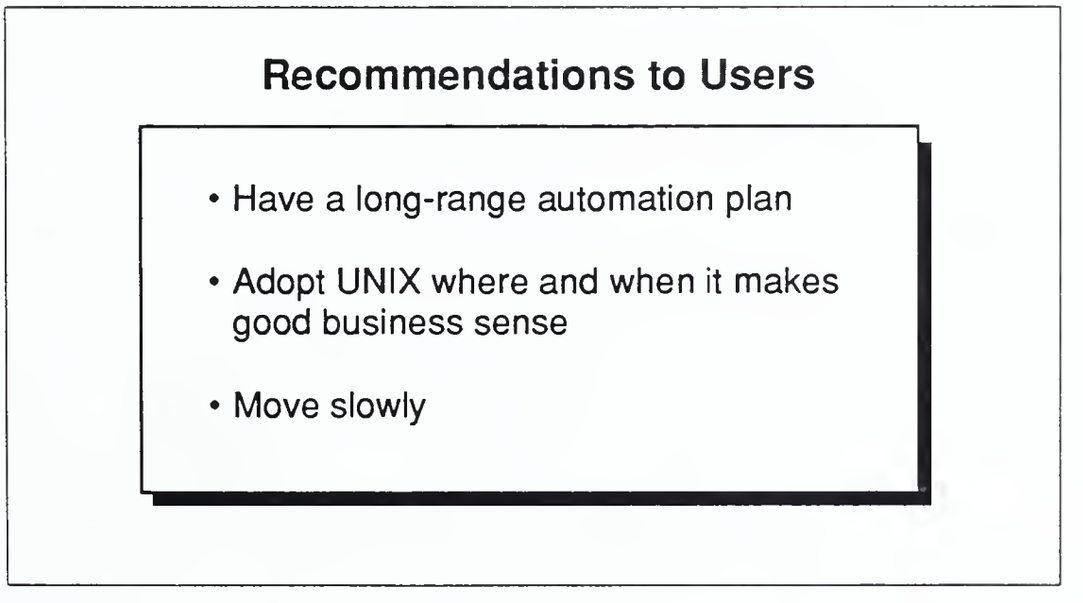
EXHIBIT II-10


Recommendations to Vendors
• Adopt any decent graphical user interface
• Develop more commercial UNIX applications
- Spreadsheets
- Accounting
- Word processing
• Application software vendors—hedge your bets
• Out-Sun Sun Microsystems

2. Recommendations to UNIX Users

Users with some level of computerization remain in the driver's seat. Don't be lulled by vendors' "sage chicken dance." As with the sage chicken dance, marked by extensive flapping of wings accompanied by loud noises, done to attract a mating partner, nothing happens immediately after. Users are getting the job done—maybe not elegantly, but some computerization is better than none. Exhibit II-11 summarizes INPUT's recommendations to users.

EXHIBIT II-11


Recommendations to Users
• Have a long-range automation plan
• Adopt UNIX where and when it makes good business sense
• Move slowly

© 1989 by INPUT. Reproduction Prohibited.

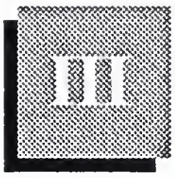
First and foremost, have a long-range automation plan. Without a map of where your company is headed, it is easy to get sidetracked. Worse, with only a cursory idea of future automation directions, it is easy to follow the wrong fork in the road. A plan, developed with the help of objective third parties, can pay huge dividends later.

With an automation plan, adopt UNIX for those applications where it is a sensible choice, given current technology and future UNIX directions.

Finally, move slowly! Nothing is worse than selecting the right hardware technology, appropriate operating system, correct applications, sufficient education and training, understandable documentation, and top-notch support services, and then creating a mess by rushing the implementation.

© 1989 by INPUT. Reproduction Prohibited.

UNIX Market Analysis



UNIX Market Analysis

A
The Computer Market

1. Market Model

A necessary first step is to create a model of the computer market for discussing the current UNIX situation and future scenarios. Exhibit III-1 presents one INPUT model of the major software components in a computer system. Please note the:

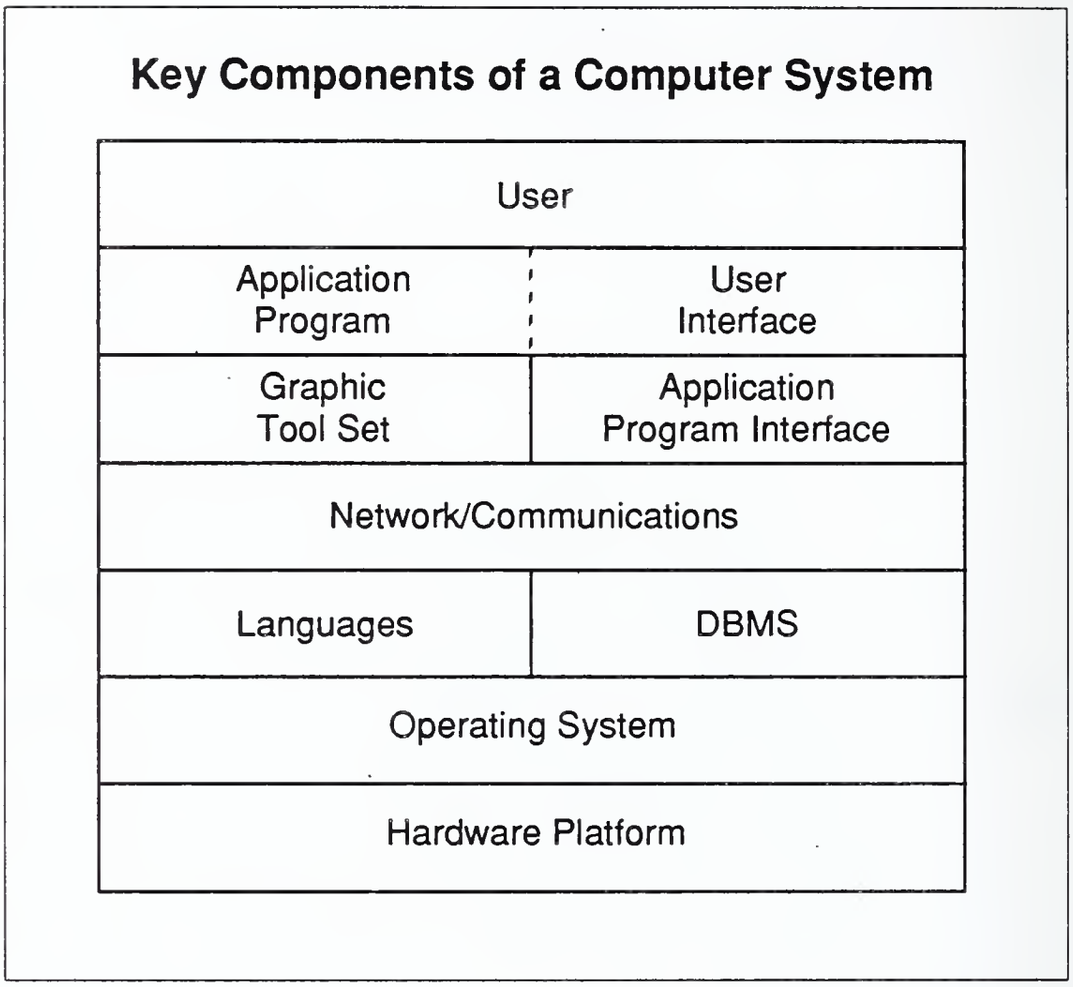
- Total number of layers between the computer hardware and the end user
- Four layers between the networking/communication layer and the end user

This general software-oriented model provides a backdrop for evaluating the UNIX market as well as proprietary environments such as IBM's Systems Application Architecture (SAA), Digital Equipment Corporation's Network Application Support (NAS), or Unisys' Solution Generation Environment.

Despite the promise of open systems and more standards, the software side of the computer industry is becoming much more complex than it was, say, five years ago. In a nutshell, growing complexity results when major hardware vendors (DEC, IBM, Hewlett-Packard, Unisys), system software vendors (The Santa Cruz Operation, Microsoft, AT&T, IBM), and relational data base vendors (Oracle, Unify, Relational Technology, Sybase, Informix) each decide they want to control one small aspect of the business, while supporting other open standards. More than ever it appears that, to paraphrase George Satayana, "No matter how much things change, they remain the same."

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT III-1



2. Expanded Market Model

In Exhibit III-2, INPUT adds substance to the market model by identifying existing and planned software products in each of the following layers:

- User interface
- Networking
- Data base management system
- High-level languages
- UNIX operating system versions

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT III-2a

Standard Software Components of a UNIX-Based System

Software Category	Examples in UNIX Environments
UNIX	BSD 4.3; OSF; AT&T System V Release 4; AT&T System V Release 3
Languages	C; C++; ANSI COBOL 85; X/Open:C; COBOL; Fortran, Pascal
DBMS	ANSI SQL; X/Open C/ISAM and SQL; NIST FIPS for SQL

EXHIBIT III-2b

Standard Software Components of a UNIX-Based System

Software Category	Examples in UNIX Environments
Networking/ Communications	TCP/IP; MAP/TOP; X/Open XTI; /USR/Group Network Interface Committee
User Interface	X-Window; X/Open; Open Look; OSF Motif

Building on the basic model, Exhibit III-3 lists the key system software subsegments of the UNIX market. The point of this list is to present the array of UNIX market subsegments. Each market subsegment addresses a different user, vendor, or software developer need, resulting in a complex market.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT III-3

Key System Software Segments in UNIX Market

Segment	Subsegments
Operating System	• Standard • On-line transaction processing • Real-time • Near real-time • Fault-tolerant
DBMS	• Relational • Non-relational
Communication Network	• Local area network • Wide area network
Application Environment	• Display manager • Graphic tool set • User interface • Application development set
Computing Environment	• Centralized • Standalone • Networked • Cooperative

Exhibit III-4 continues INPUT's high-level overview of the UNIX computing environment, presenting select options in:

- Computing environment
- UNIX-based operating systems
- Operating system environments
- Data base management systems

Taking a slightly different approach, this demonstrates the range of choices still available to the user, despite the growing trend of many vendors toward using UNIX-based standards. In short, what appears to be happening is a re-creation of the computer industry with a more bewildering array of choices than before.

© 1989 by INPUT. Reproduction Prohibited.

Using a matrix approach, users can mix and match the computing environment and the basic operating system version, with the OS environment and the data base management software. For the sake of argument, 160 different UNIX operating approaches are possible (4 environments x 4 operating systems x 5 operating system environments x 2 DBMS environments). While not all permutations yield true UNIX operating environments, the fact remains that the number of choices available to the user and the concomitant support requirements for vendors is very large.

EXHIBIT III-4

Matrix of UNIX Computing Environments

Computing Approach	UNIX-Based Operating System	Operating System Environment	DBMS
Centralized	UNIX Int'l.	Standard	Relational
Decentralized • Standalone • Networked • Cooperative	OSF	OLTP	Non-relational
	XENIX	Real-time • Near • True	
	Proprietary enhanced	Fault-tolerant	

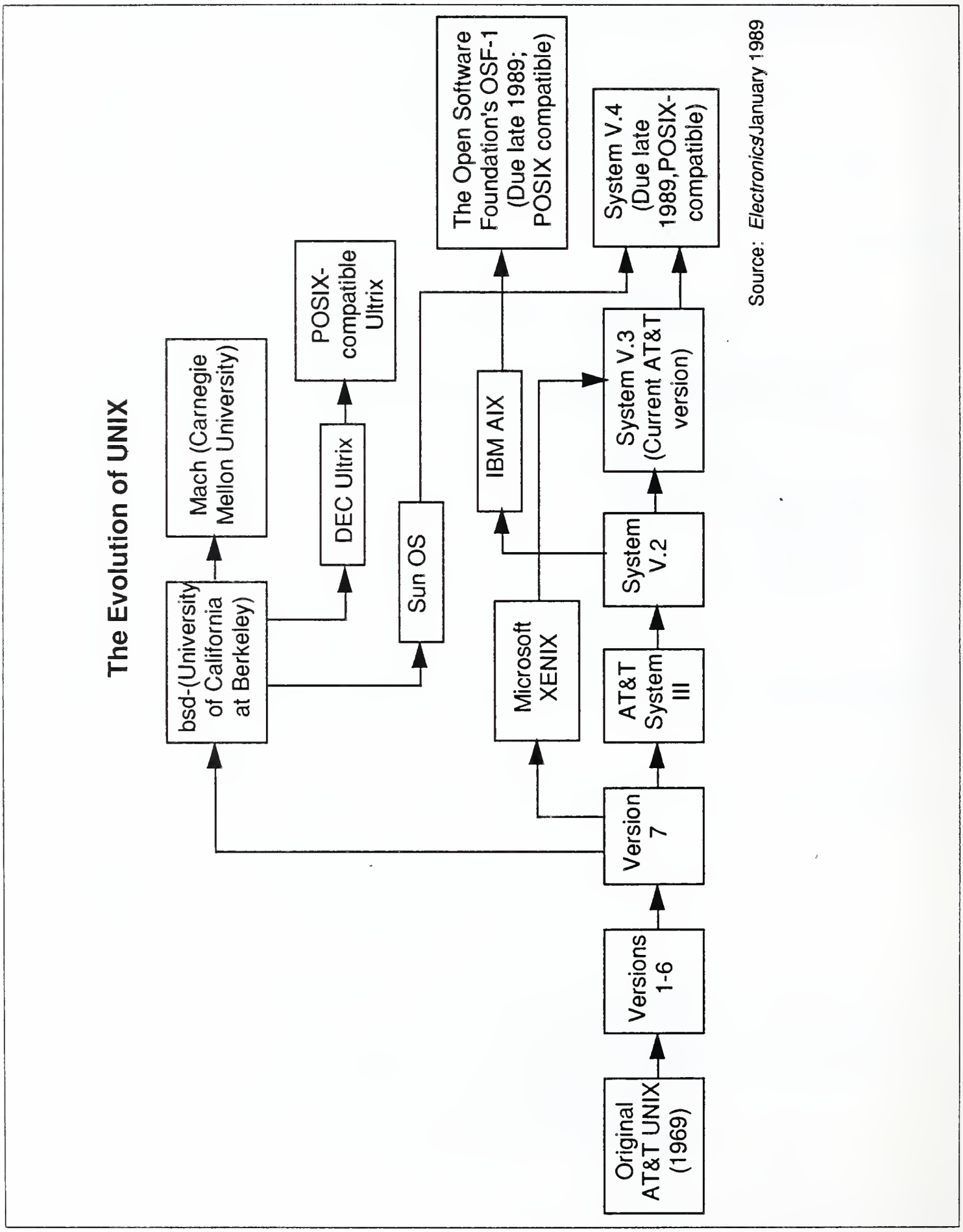
3. Evolution of UNIX

UNIX, created in 1969 by two AT&T researchers, is loosely based on Honeywell's MULTICS mainframe operating system. Industry lore has it that the name UNIX was selected to represent a "castrated MULTICS."

Since 1969, UNIX' growth and enhancements have been spurred by efforts at AT&T Laboratories and two universities—California at Berkeley and Carnegie Mellon. Berkeley created the bsd (Berkeley Software Distribution) version while Carnegie Mellon, working with the Department of Defense Advanced Research Projects Agency, has created its "Mach" multiprocessor version of UNIX. Exhibit III-5 shows the evolution of UNIX, eliminating proprietary enhancements by hardware vendors such as Digital Equipment (Ultrix), Amdahl (UTS), Hewlett-Packard (HP-UX), and Data General (MV/UX).

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT III-5



© 1989 by INPUT. Reproduction Prohibited.

4. Market Segments

Using common definitions is very important in the UNIX market. To be consistent, INPUT hardware system categories are broken down into traditional computer hardware classifications. Exhibit III-6 places supercomputers, minisupercomputers and mainframes into INPUT's mainframe category. Superminicomputers and minicomputers together equal the minicomputer category. Personal computers and technical workstations comprise INPUT's category of the same name. These terms will be used when discussing the various market segments.

EXHIBIT III-6

Hardware Segment Definitions

Traditional Hardware System Category	INPUT Hardware System Category
Supercomputer Minisupercomputer Mainframe	Mainframe
Superminicomputer Minicomputer	Minicomputer
Technical Workstations Personal Computers	Workstation/ Personal Computer

B

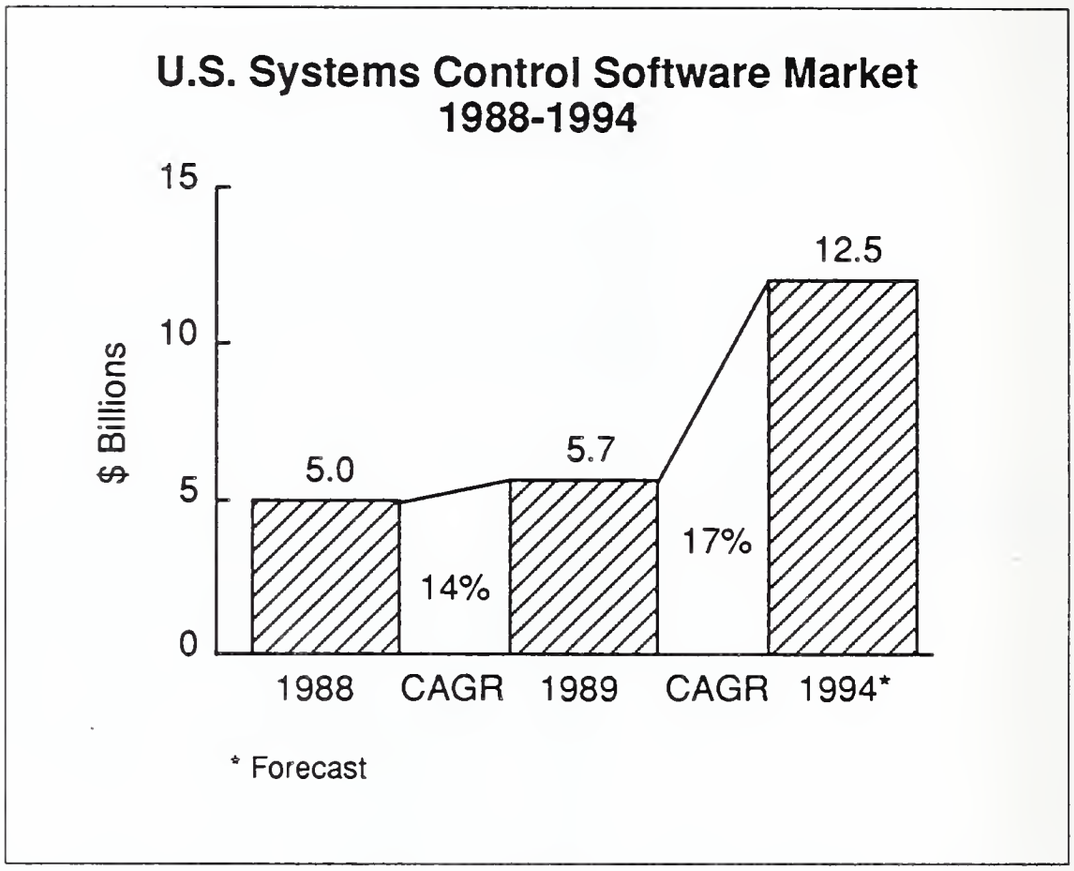
UNIX Operating System Market

1. Size of the U.S. Operating System Market

To set the stage for discussing the UNIX market, it is necessary to first show the size of the U.S. market for all operating systems. According to Exhibit III-7, the U.S. operating system market was approximately $5.0 billion in 1988, growing 14% in 1989 to $5.7 billion, and projected to grow at 17% thereafter to just over $12.5 billion in 1994.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT III-7



This market data includes the value of licensed operating system software for mainframes, minicomputers, personal computers, and workstations. Exhibit III-8 divides the 1989 U.S. market into three primary components:

- Mainframe
- Minicomputer
- Personal computer/workstation

The largest market segment in 1989, mainframes, is expected to grow at 14% compounded, to about $5.2 billion in 1994. Workstations/personal computers will grow at 25% compounded by 1994 to $3.8 billion, taking over second place from minicomputers. The growth in personal computers will be driven by new hardware platforms, new operating systems, and the growth in local area networks (LANs).

2. Size of the Overall U.S. Market for UNIX

Information on the size of the overall U.S. UNIX market, the major segments, and the leading vendors is presented in the following 16 exhibits. Taking a top-down view, the value of UNIX licenses represents 14% of the $5.7 billion overall operating system market in 1989. Please refer to Exhibit III-9.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT III-8

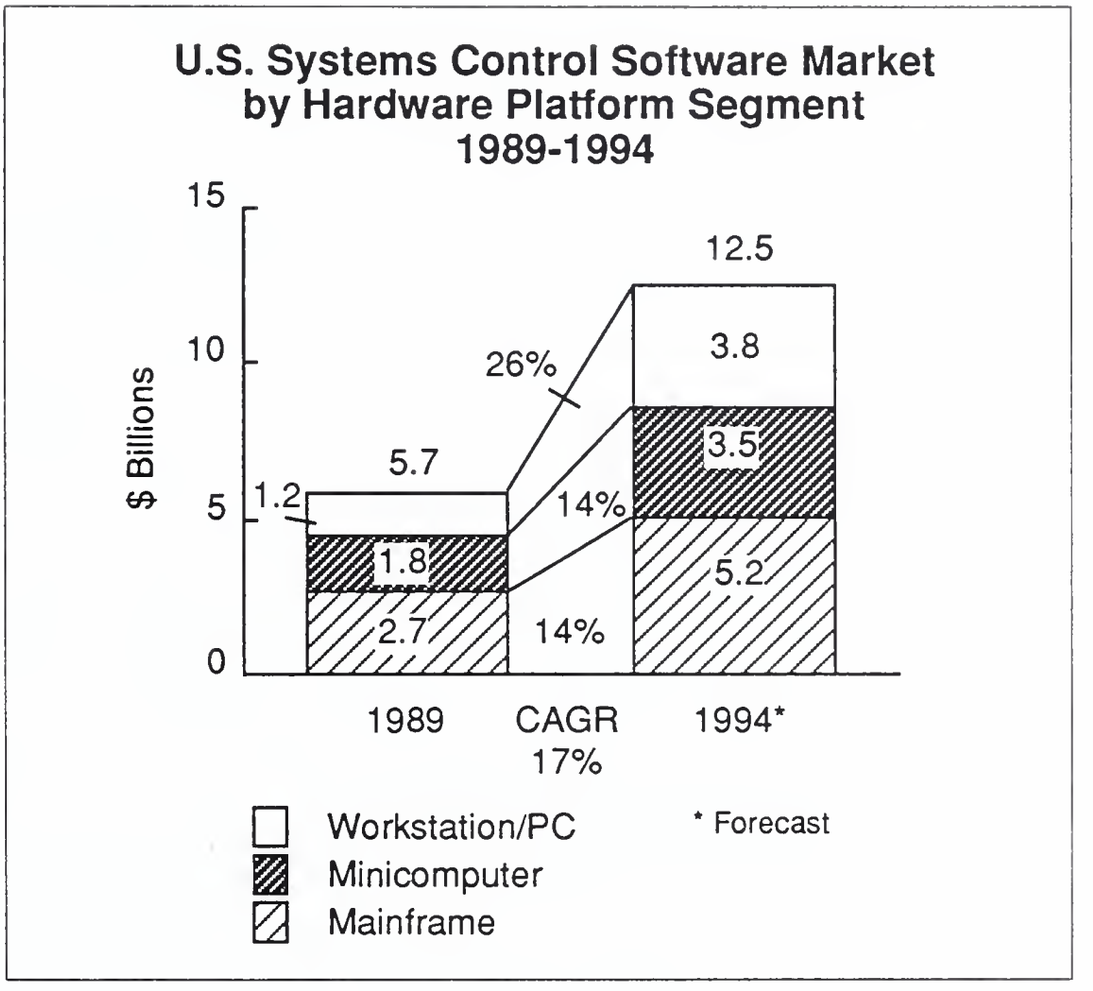
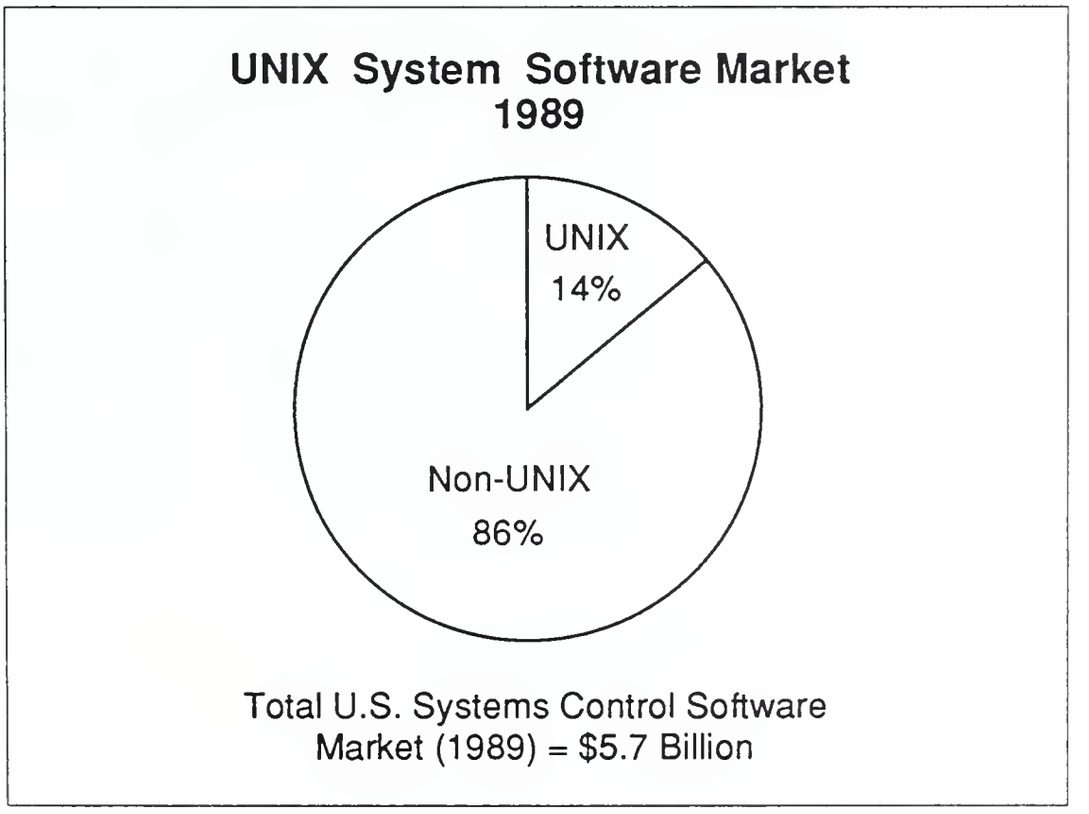


EXHIBIT III-9a

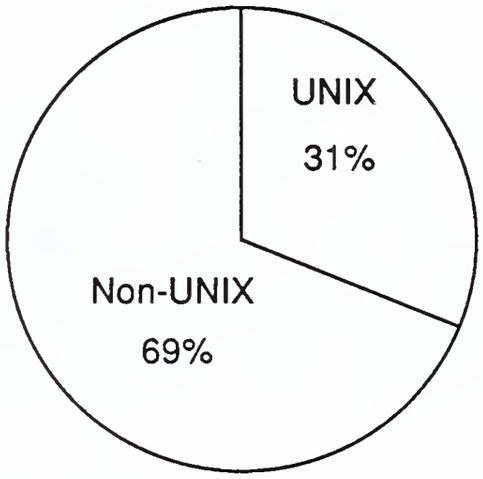


© 1989 by INPUT. Reproduction Prohibited.

By 1994, INPUT expects UNIX software licenses to represent just over 30% of the $12.5 billion U.S. software market. The growth in revenues will be due, in part, to increased licensing fees for UNIX.

EXHIBIT III-9b

UNIX System Software Market 1994



Total U.S. Systems Control Software Market (1994) = $12.5 Billion

As shown in Exhibit III-10, UNIX and UNIX derivatives represent only about 7% of the total number of cumulative operating system licenses (not those licenses paid in 1988). Although UNIX celebrated its 20th anniversary in August 1989, its success to date has been relatively limited.

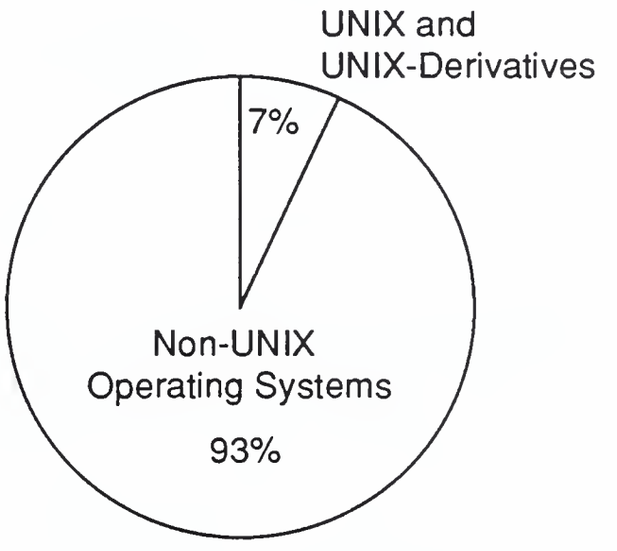
3. Size of the U.S. Mainframe Market for UNIX

In the U.S. mainframe market, UNIX represents only 4% of cumulative operating system licenses through 1989. IBM MVS/XA/VM operating systems hold nearly two-thirds of the market, indicated in Exhibit III-11, reflecting the company's solid mainframe market position. IBM has delayed releasing its AIX version of the UNIX operating system until the first quarter of 1990.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT III-10

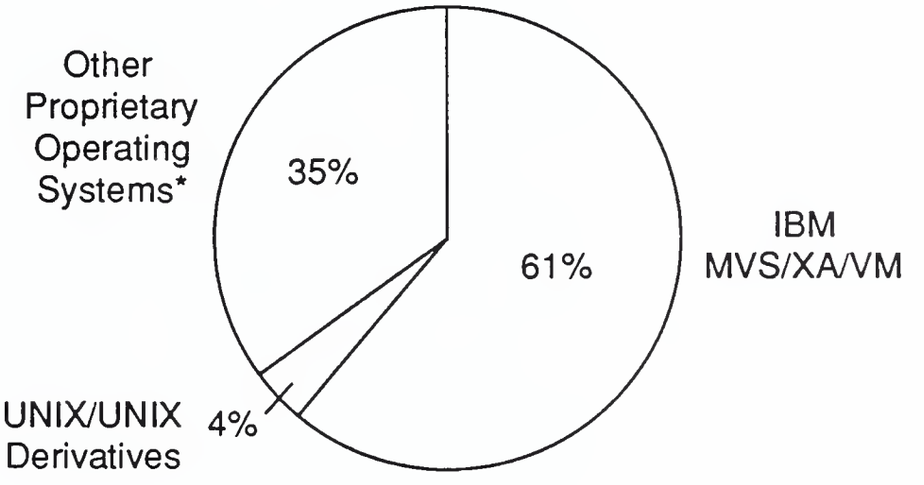
UNIX Proportion of Total U.S. Operating System Market as of 1989



Percent of number of
cumulative operating system licenses

EXHIBIT III-11

U.S. Mainframe Systems Control Software Market



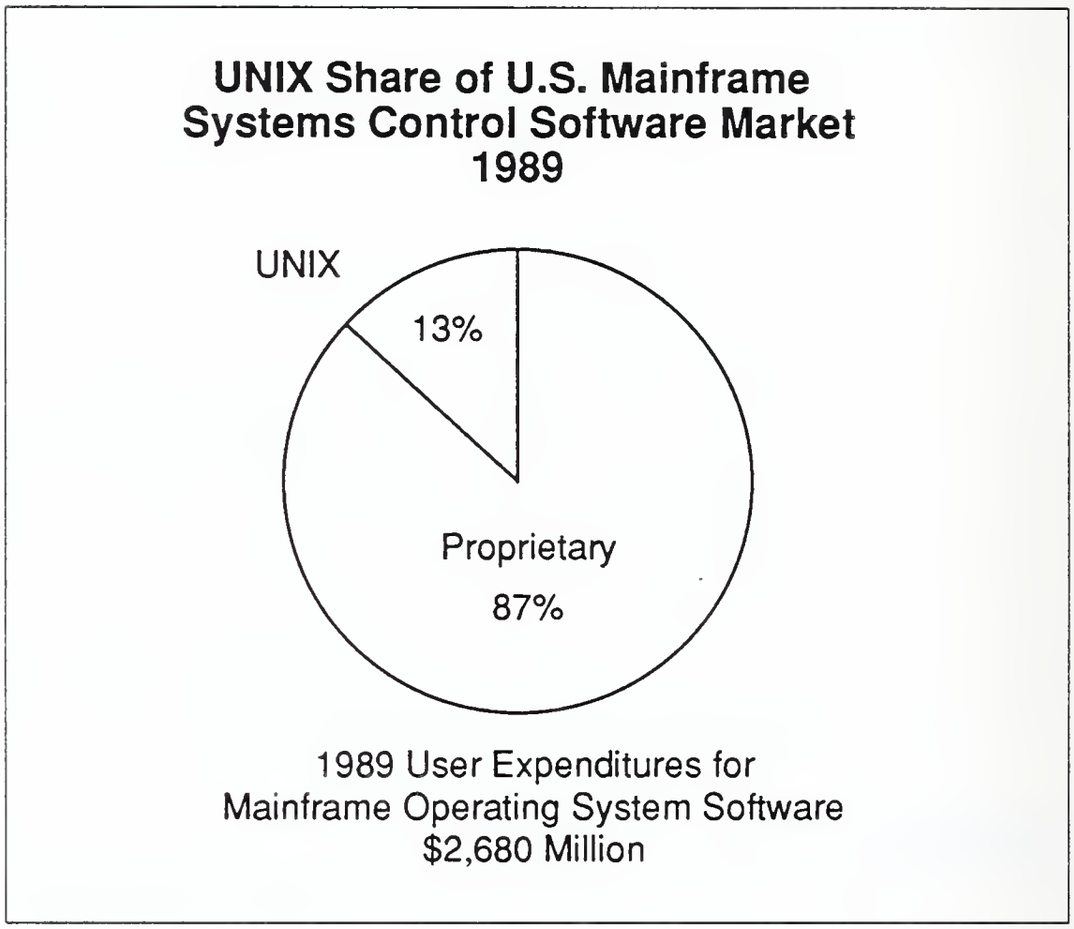
Percent of number of cumulative
operating system licenses through
1989

* Honeywell, Unisys, CDC, NCR, etc.

© 1989 by INPUT. Reproduction Prohibited.

UNIX and UNIX derivatives represented 13% of the $2.7 billion annual value of operating system licenses in 1989, shown in Exhibit III-12.

EXHIBIT III-12



The growth of UNIX in the mainframe market is due to Amdahl's success with its UTS operating system, which was required by the telecommunications industry. As stated previously, IBM has not released its AIX version of UNIX. AIX was scheduled for release in March 1989, was delayed until the fourth quarter of 1989, and then further delayed until the first quarter of 1990. The delay may represent a strategic move by IBM to promote its proprietary MVS and XA operating systems while there is confusion in the UNIX market. Exhibit III-13 lists UNIX operating system products from the leading mainframe vendors.

Looking ahead to 1994, UNIX will take nearly one-quarter of the $5.1 billion U.S. mainframe operating system market, shown in Exhibit III-14. Users are expected to adapt IBM's AIX product and continue their strong support of Amdahl's UTS implementation. As in other market segments, IBM's entry certainly legitimizes that market and, despite its product weaknesses, AIX will undoubtedly boost the overall UNIX market.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT III-13

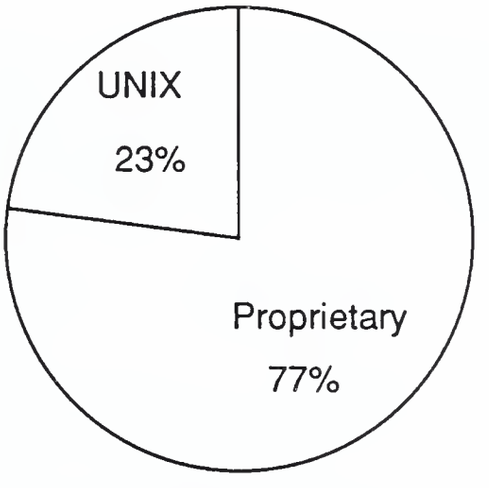
Leading Mainframe Vendors Offering UNIX

Company	UNIX-Based Product(s)
Amdahl	UTS; UNIX
IBM	AIX*

* AIX was scheduled for release in March 1989; delayed until first quarter 1990

EXHIBIT III-14

UNIX Share of U.S. Mainframe Shipments, 1994



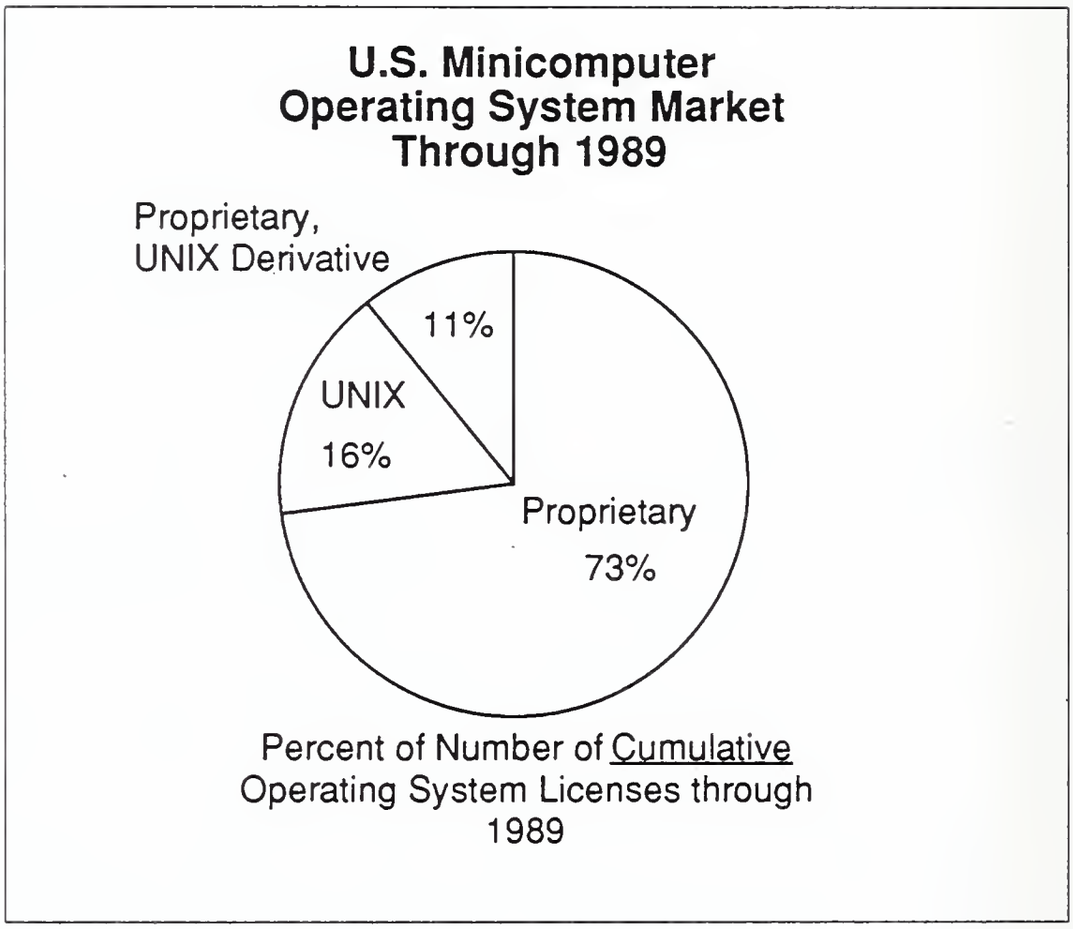
1994 User Expenditures for
Mainframe Systems Control Software
$5,160 Million

© 1989 by INPUT. Reproduction Prohibited.

4. Size of the U.S. Minicomputer Market for UNIX

In the U.S. minicomputer market, UNIX represents more than one-fourth of the cumulative operating system licenses through 1989. Proprietary operating systems, led by Digital Equipment's VAX/VMS product, hold more than 70% of the market, indicated in Exhibit III-15.

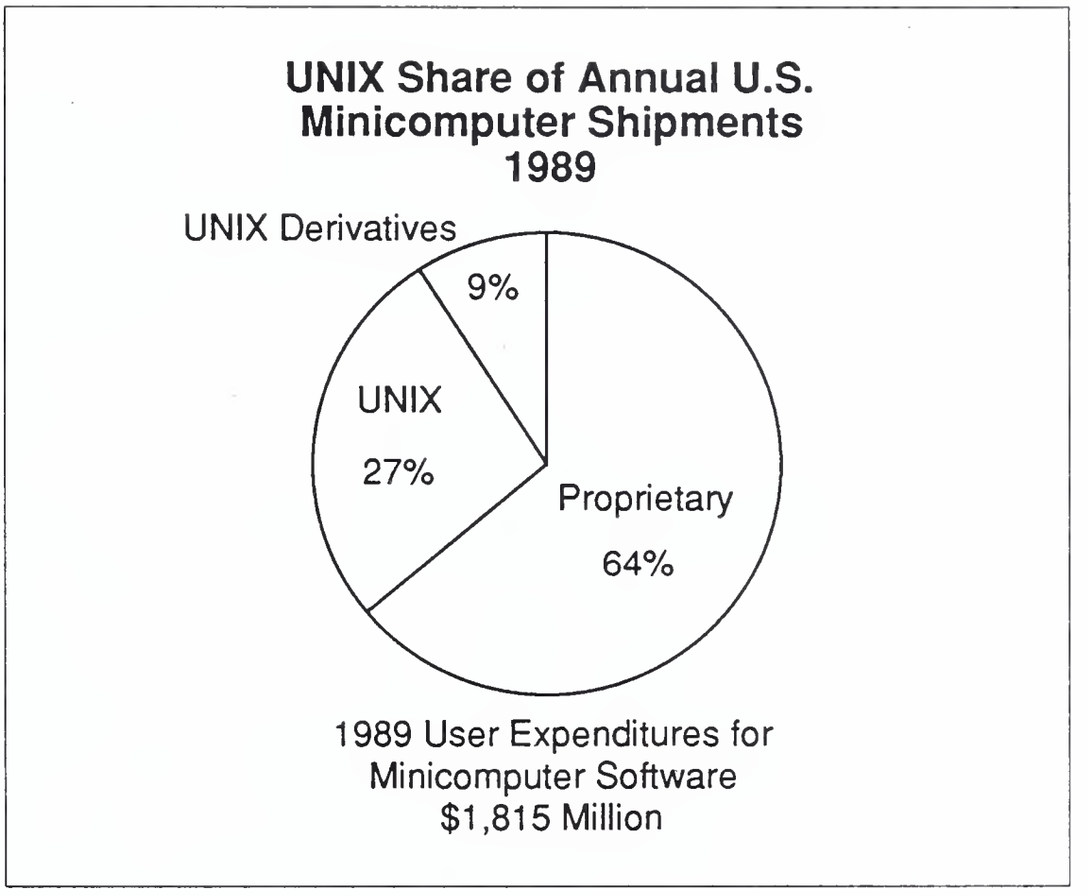
EXHIBIT III-15



On the basis of 1989 operating system licenses, UNIX and its proprietary derivatives garnered 36% of the nearly $1.8 billion minicomputer operating systems market in the U.S. Exhibit III-16 indicates that "vanilla" UNIX (AT&T System V or bsd 4.X versions) outdrew proprietary derivatives by a factor of three to one. This phenomenon can be attributed to the initial development of UNIX on Digital Equipment PDP-8 minicomputers and migrating through the PDP-11 family to Digital's current VAX architecture. Furthermore, superminicomputers' genesis was scientific/technical computing—precisely the applications where UNIX has been best used.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT III-16



As shown in Exhibit III-17, nearly every minicomputer manufacturer offers either "vanilla" UNIX or a proprietary enhanced version. As minicomputer distribution has evolved to more OEM relationships, selecting a neutral operating system makes tremendous sense for all parties.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT III-17

Minicomputer Vendors Offering UNIX

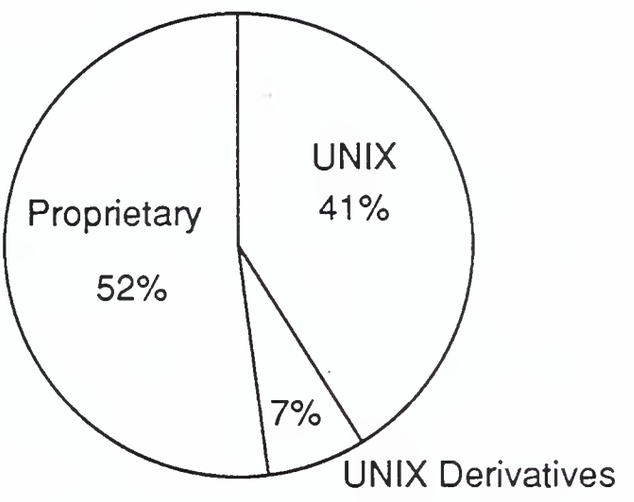
Vendor	UNIX-Based Product(s)
Digital Equipment	ULTRIX-32; UNIX
Gould/Encore	UTX
Harris	UNIX
Prime	UNIX
Pyramid	OSX; UNIX
Ridge	UNIX
Sequent	DYNIX; UNIX
ARIX	UNIX
AT&T	UNIX
C. ITOH Electronics	UNIX
Charles River Data	UNOS; UNIX
Computer Consoles	UNIX
Concurrent/Masscomp	XELOS; UNIX
Encore	UMAX; UNIX
Hewlett-Packard	HP-UX; UNIX
MAI/Basic Four	BOSS/IX; UNIX
Motorola Comp. Systems	UNIX
NCR	UNIX
NEC Information Systems	UNIX
Texas Instruments	TI System V; UNIX
Unisys	UNIX
WICAT	UNIX
Data General	DF/UX; UNIX
Cromemco/Dynatech	CROMIX; UNIX
CYB Systems	Uniplus+; UNIX

© 1989 by INPUT. Reproduction Prohibited.

By 1994, INPUT expects UNIX to represent nearly one-half of the $3.5 billion market for minicomputer operating systems. Please note that the forecast value of AT&T UNIX, shown in Exhibit III-18, will be nearly six times that of UNIX derivatives. It is expected that more users in the minicomputer area will specify standard UNIX rather than a proprietary, enhanced version. Furthermore, it is likely that AT&T will market performance extensions of UNIX such as support for a fault-tolerant environment, real-time computing, transaction processing, or various combinations.

EXHIBIT III-18

Forecast UNIX Share of Annual U.S. Minicomputer Shipments 1994



1994 User Expenditures for Minicomputer Operating System Software
$3,495 Million

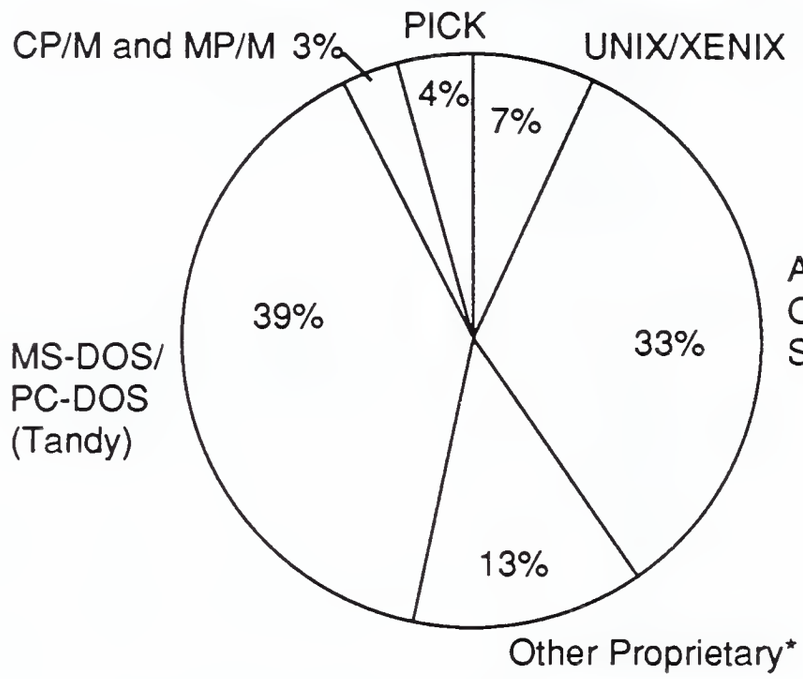
5. Size of the U.S. Workstation/Personal Computer Market for UNIX

As shown in Exhibit III-19, the number of licenses for UNIX and derivative operating systems represent 7% of cumulative operating system licences through 1989. The dominant low-end operating systems, MS-DOS/PC-DOS and Apple, account for 39% and 33% of cumulative licenses. The 7% UNIX proportion includes XENIX licenses and is installed mainly on workstations and higher performance personal computers.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT III-19

U.S. Workstation/Personal Computer Operating System Market



Percent of Number of Cumulative Operating System Licenses through 1989

* Atari, Commodore, Osborne, etc.

The next three charts, Exhibits III-20 through III-22, list UNIX products from workstation, personal computer hardware, and personal computer software vendors respectively.

EXHIBIT III-20

Workstation Vendors Offering UNIX

Workstation Vendor	UNIX-Based Product(s)
Sun	SunOS; UNIX
Apollo	Domain IX; UNIX
IBM (RT)	AIX; UNIX
Hewlett-Packard	HP-UX; UNIX

© 1989 by INPUT. Reproduction Prohibited.

In the technical workstation area, the leading vendors' products run UNIX or a derivative. While HP and Apollo merged a few months ago and the challenge will be to consolidate their product offerings, the challenge is made somewhat easier since UNIX is included in each vendor's products.

EXHIBIT III-21

Personal Computer Equipment Vendors Offering UNIX

Vendor	Product(s)
Altos	Altos System V
Apple (Macintosh)	A/UX
AT&T	UNIX
CAE/SAR Systems	UNIX
Compaq	XENIX
Convergent	CTIX; UNIX
Fortune	FOR:PRO; UNIX
IBM (PC)	UNIX
IBM (PS/2)	AIX PS/2; UNIX
Intel	XENIX
Rexon	XENIX
Scientific Micro Systems	XENIX
Tandem	XENIX
Tandy	iRMX; XENIX
Wang	XENIX
Wyse	UNIX
Zenith	XENIX

UNIX and XENIX run on practically every major brand of personal computer (PC), including IBM clones. AT&T's newest UNIX version, V.3, incorporates many of the features of XENIX and bsd 4.3, offering a single OS standard running on powerful PCs. However, despite this consolidation, the great majority of the UNIX-related installed PC base

© 1989 by INPUT. Reproduction Prohibited.

runs XENIX. As listed in Exhibit III-21, The Santa Cruz Operation (SCO) sells most of the XENIX packages. According to SCO, XENIX System V comprises 90% of all UNIX systems installed on PCs, with more than 350,000 operating system licenses sold through early 1989.

EXHIBIT III-22

Personal Computer Software Vendors Offering UNIX

Vendor	Product(s)
The Santa Cruz Operation	XENIX
Microport*	System V/AT; System V/286; System V/386
Microsoft	XENIX
SBE, Inc.	Regulus
Software Components Group	pSOS-68K
Unisoft	UniPlus+ System V.3
Venturcom	VENIX/System V
Whitesmiths	IDRIS
Mark Williams Co.	Coherent

* Ceased operations in June 1989

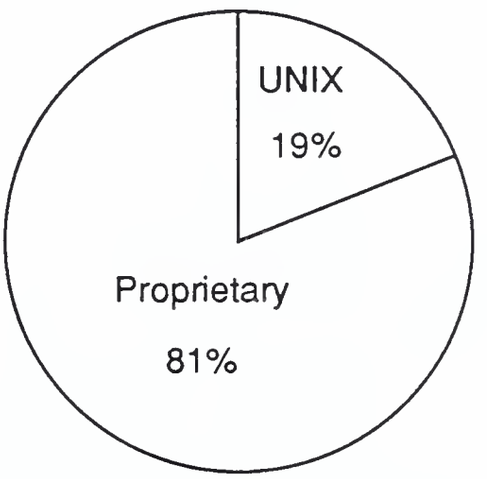
Translating the above information into market share, UNIX licenses represented 19% of the $1.2 billion market in 1989 for all workstation/ personal computer operating system licenses (see Exhibit III-23). PCs represent a substantial portion of the total market figure. While nearly 100% of workstations run UNIX, only about 130,000 workstations were shipped in 1989 compared to 5-6 million PCs in the U.S.

UNIX licenses will account for an estimated 28% of nearly $3.8 billion 1994 annual U.S. shipments of workstations and PCs. Please refer to Exhibit III-24 for details. INPUT expects UNIX to grow consistently in the personal computer market, especially in late 1989 and all of 1990, while IBM and Microsoft enhance the proprietary OS/2 to match the multi-user, multi-tasking, and strong network communications features of UNIX. Sophisticated users clearly want these features and see little reason to wait.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT III-23

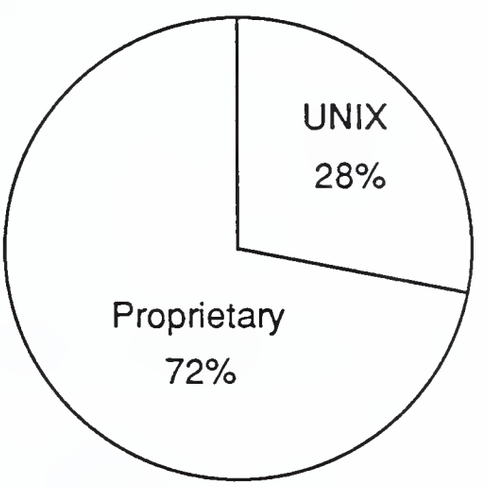
UNIX Share of Annual U.S. Workstation/ Personal Computer Shipments 1989



1989 User Expenditures for
Workstation/PC Operating System Software
$1,200 Million

EXHIBIT III-24

UNIX Share of Annual U.S. Workstation/Personal Computer Shipments 1994



1994 User Expenditures for
Workstation/PC Operating System Software
$3,800 Million

© 1989 by INPUT. Reproduction Prohibited.

C

Primary User Applications in the UNIX Market

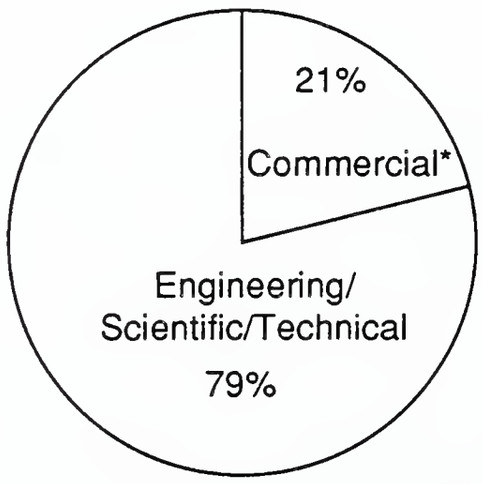
INPUT user surveys in late 1988 and early 1989 show nearly a four-to-one ratio of engineering/scientific/technical applications to commercial applications. As indicated in Exhibit III-25, commercial applications include:

- Office automation
- Accounting
- Inventory control
- Human resources
- Payroll
- Decision support
- Purchasing

Explanations include: (1) UNIX began in the technical market and has prospered in that domain due to the proliferation of technical software; (2) Application software for commercial applications, especially spreadsheets, has been slow in coming; (3) UNIX in commercial applications has been available mainly through turnkey system sellers or other value-added resellers (VARs), raising the cost and requiring expert assistance to install; (4) UNIX is perceived as hard to use or difficult to adapt to commercial environments.

EXHIBIT III-25

UNIX Market by Primary Application
1989



* Includes: Office automation; accounting; inventory control; personnel; payroll; decision support; purchasing; industry-specific applications

© 1989 by INPUT. Reproduction Prohibited.

UNIX will expand in commercial applications when:

- More commercial application software becomes available
- Window-based graphical user interfaces (GUI) become widespread
- UNIX becomes easier to install
- UNIX software is sold through retail stores such as Businessland and Egghead Discount Software.

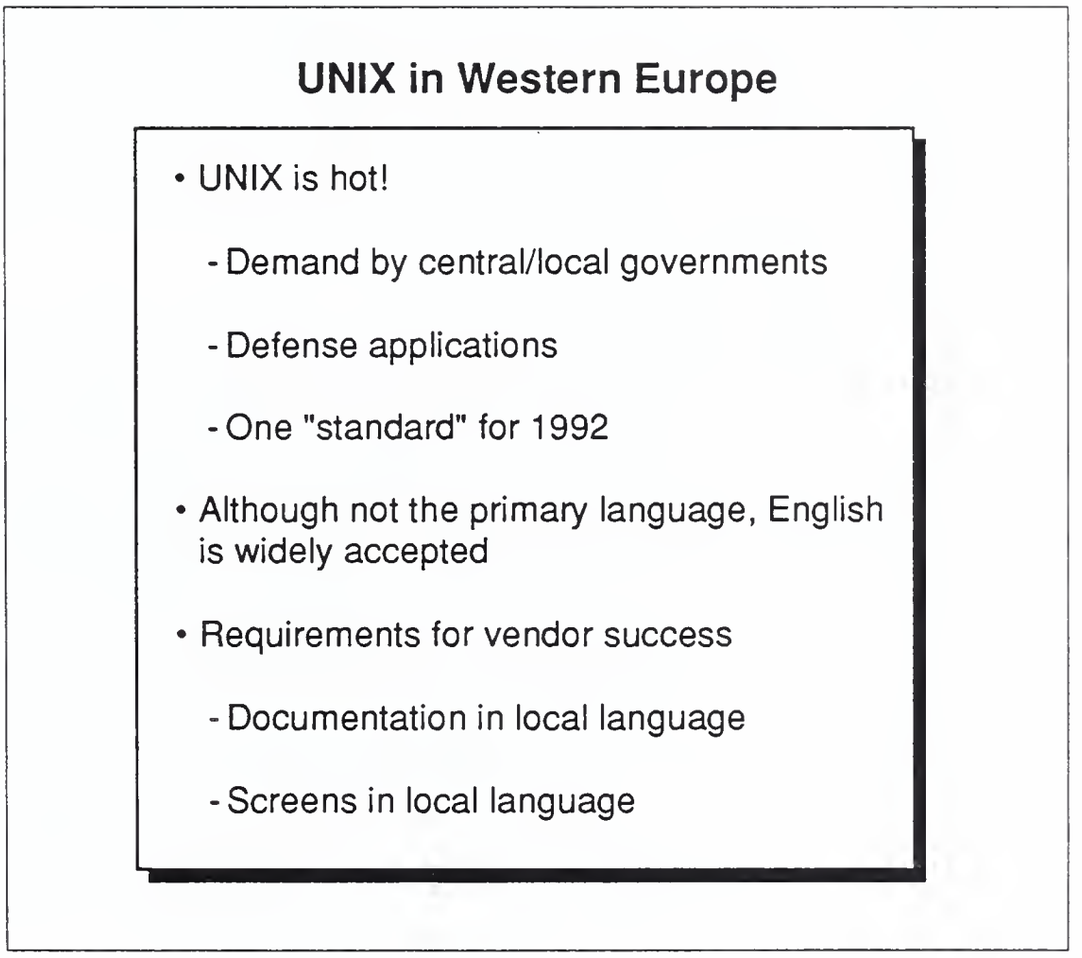
D

UNIX in Western Europe and Japan

1. UNIX in Western Europe

In western and northern Europe, UNIX is hot! Furthermore, it appears that the European market in UNIX does not lag behind the U.S. by the traditional two-year period. In fact, one might say that Europe is leading in some aspects of UNIX. Exhibit III-26 summarizes the issues in Europe.

EXHIBIT III-26


UNIX in Western Europe
• UNIX is hot!
- Demand by central/local governments
- Defense applications
- One "standard" for 1992
• Although not the primary language, English is widely accepted
• Requirements for vendor success
- Documentation in local language
- Screens in local language

© 1989 by INPUT. Reproduction Prohibited.

UNIX has had a solid foundation in Europe since it is, for better or worse, a standard product. Although written in English rather than in local languages, English is acceptable in computer applications. Local and central governments have specified UNIX for a few years, for general operations as well as for NATO defense applications. Quite importantly, it is one standard that can be agreed to for the 1992 European economic consolidation, easily reducing the number of items to be agreed on before 1992.

In Europe, although English is acceptable, nationalism dictates that successful vendors make local accommodations. Especially important is rewriting the documentation and the computer screens, including menus, in the language of the local country. For example, NCR Corporation rewrote its documentation and screens in Spanish and, as a result, has been very successful in Spain and other Spanish-speaking markets.

Other European market driving forces for UNIX, specified in Exhibit III-27, include making it easier to compete with U.S. vendors in Europe, a very important consideration in the mid-range systems market. Four leading vendors of turnkey systems running proprietary operating system software experienced major declines in their business in 1987-88. As a result, Nixdorf, Norsk Data, Nokia, and Kienzle will incorporate UNIX into future turnkey systems.

2. UNIX in Japan

In Japan, three large firms, listed in Exhibit III-28, are helping promote UNIX acceptance in the market. Yokogawa Hewlett-Packard offers UNIX on its workstations, while Rikei Corp. and Matsubo Equipment and Instrument Corp. resell superminicomputers running the Mach operating system. UNIX has been most successful in Japan in the engineering/ scientific/technical market. Acceptance in business applications or office systems has been relatively slow, since end users are not yet familiar with UNIX. And though all mainframe manufacturers provide UNIX, its use on mainframes has been limited.

Poor Japanese language processing capabilities are another barrier to acceptance of UNIX. Since few UNIX products have been translated into Japanese, the safest approach to this market for U.S. vendors is to use local representatives. In addition, forming joint ventures assures a "win-win" situation for all participants.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT III-27

UNIX in Western Europe

- Role of UNIX to hardware vendors
  - "Total solution"
  - Break down national barriers
  - Easier to compete with U.S. computer system manufacturers
- UNIX focused on Mid-Range Systems
  - Unisys
  - Hewlett-Packard
  - Olivetti
  - ICL
- Turnkey system vendors moving to UNIX
  - Nixdorf (West Germany)
  - Norsk Data (Norway)
  - Nokia (Finland)
  - Kienzle (West Germany)

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT III-28

UNIX Sales Activities in Japan

Vendor	Products/Services
Yokogawa Hewlett-Packard (Tokyo)	• Transfer OS & UNIX R&D to Kobe, Japan • Plans to open second R&D center in 1991 • Investment: 10 billion yen
Rikei Corp. (Tokyo)	• Resells minisupercomputer running Mach UNIX-based operating system
Matsubo Equipment & Instrument Corp. (Tokyo)	• Resells Sequent superminicomputers running the Mach operating system

Distributors, computer manufacturers, and third-party software houses are writing UNIX-based software. Distributors include:

- C. Itoh
- Techno-Science
- ASCII
- SRA
- Toyo Information Systems

An interesting parallel between the U.S. and Japanese UNIX markets is the proliferation of UNIX-based standards organizations. The role of U.S.-based UNIX consortia is discussed more fully in the next chapter. In Japan, three groups, listed in Exhibit III-29, have formed to promote different versions of UNIX, and conduct end user education and training in UNIX.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT III-29

UNIX Organizations in Japan

Organization	Activities	Sponsor(s)
Unisol Corp. (Tokyo)	• Develop Japanese-based UNIX and Open Look software • Sell software • Funding at $4 million	• Sun • Fuji Xerox
PFU, Ltd. (Tokyo)	• Establish a UNIX information and technical service center	• Fujitsu • Matsushita • Uchida Yoko
Sigma System Development Department (Tokyo)	• Promotes the "Sigma Project," which standardizes on UNIX System V, Release 2.0 • May adopt more up-to-date UNIX specifications	• Information Technology Promotion Agency (IPA)

E

UNIX-Related Mergers and Acquisitions

INPUT's research identified only one major UNIX-related merger. Kodak subsidiary Interactive Systems (Santa Monica, CA) acquired Lachman Associates (Naperville, IL) (see Exhibit III-30). The resulting firm will be a powerhouse in UNIX-related professional services, software development, and telecommunications products.

EXHIBIT III-30

Mergers and Acquisitions in the UNIX Market

Category	Vendors	Specialization
Acquired	Interactive Systems Corp. (subsidiary of Eastman Kodak) Lachman Associates (Naperville, IL)	• Systems software • Telecommunications products; professional services

© 1989 by INPUT. Reproduction Prohibited.

F

UNIX Software Distribution

Product distribution is an important consideration in any market study. Although to date UNIX software has been distributed mainly by turnkey system vendors and other value-added resellers, leading software distributors also want a piece of the UNIX action. To be prepared, the vendors listed in Exhibit III-31 are now distributing UNIX-related hardware or software.

Businessland and Oracle are assembling a complete solution package; Ingram (through its Micro D and Ingram Computer subsidiaries) is starting off by selling hardware; the remaining vendors are selling various application and/or system software, generally to VAR customers.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT III-31

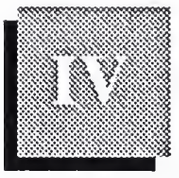
U.S.-Based Distributors of "Shrink-Wrapped" UNIX Software Products

Distributor	Number of VAR Customers	Vendor(s) Represented
Ingram Computer Buffalo, NY	N/A	AT&T (hardware; software; StarLAN)
GTE Data Products Salt Lake City, UT	400	AT&T (system & application software)
MicroAge/PGI Tempe, AZ	N/A	IBM (AIX PS/2 operating system)
Businessland San Jose, CA	N/A	NeXT; IBM (AIX PS/2 operating system)
Ingram Micro D Santa Ana, CA	3,500	Motorola Computer Systems (hardware)
Dickens Data Systems Norcross, GA	N/A	IBM (AIX PS/2 operating system); Samna; Santa Cruz Operation
Microamerica Waltham, MA	N/A	VersaCad; AutoDesk
Softsel Inglewood, CA	5,000	Interactive Systems Corp. (software products)
UniMarket/UniPress Edison, NJ	N/A	Uniplex; Santa Cruz Operation; Progress Software; Microsoft
Oracle Corporation Belmont, CA	N/A	Access Technology; Information Builders; Progress Software; Quadraton; Unify; Verity

© 1989 by INPUT. Reproduction Prohibited.

© 1989 by INPUT. Reproduction Prohibited.

UNIX Operating System Environment



UNIX Operating System Environment

A Introduction

This chapter will help the reader better understand two big mysteries in computing:

- What consortia are influencing the UNIX market?
- Why are these groups taking these steps?

INPUT is taking a different approach in understanding the UNIX operating system environment. To address these issues, it has summarized key information on each UNIX organization in the format shown in Exhibit IV-1. While this format will enable the reader to quickly understand each organization, INPUT adds exhibits linking information on key organizations as necessary.

EXHIBIT IV-1

UNIX Lobbying Organization Profile Format

Profile:

Founded:

Location(s)

Goals:

Work Groups:

Member Companies/Organizations:

© 1989 by INPUT. Reproduction Prohibited.

The data contained in each profile is based on press materials, secondary research, and advertisements in computer industry periodicals. Information in each exhibit is current as of the date specified. If none is specified, then information is current as of October 1989.

B

Organizations Focusing on UNIX System Software

This section looks at industry consortia focusing on UNIX-based system software, and is divided into primary and secondary organizations, as follows:

Primary
- UNIX International (UI)
- Open Software Foundation (OSF)
- X/Open Ltd.

Secondary
- Open Desktop Group
- Object Management Group
- Strategies for Open Systems

1. Primary UNIX Industry Consortia

The primary goal for UNIX International and Open Software Foundation centers around developing a version of UNIX for commercial computing environments.

Exhibits IV-2 through IV-5 present summary information on the two leading UNIX not-for-profit organizations. UI has more members, including vendors of traditional mid-range systems and many of the leading UNIX system software vendors.

Although this is a simple goal, industry politics have complicated the situation in the following ways:

First, AT&T and Sun Microsystems aligned to form UI, while key OSF supporters include IBM and Digital Equipment.

Second, these alliances have restricted the ability to implement the best current technology, and to create optimal versions of UNIX.

Third, and very important, software developers are unsure which "camp" to bet on, delaying the introduction of new system and application software products.

Fourth, users with commercial applications may delay adopting UNIX until the situation is resolved or one side is perceived as assuming leadership.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT IV-2

Profile: UNIX International (UI)

Founded:	November 1988
Locations:	Parsippany, NJ; Boston; Los Angeles; Tokyo, Japan; Brussels, Belgium
Goals:	Set product and technology directions for System V operating system
Work Groups:	Multiprocessing Security User interface

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT IV-3

UNIX International Members

Hardware Vendors

Acer	Gould	Pyramid
Alcatel-SMH	ICL	Ricoh
Alliant	Integrated Solutions	Sequent
ARIX	Intel	Sequoia
AT&T	Interactive Systems	Silicon Graphics
C. ITOH	L.M. Ericsson	Sony
Comptuer Consoles	MIPS Computers	Stellar
Concurrent	Modcomp	Stratus
Control Data	Motorola	Sun
Convergent	NCR	Tandem
Data General	NEC	Tata
Dell Computer	OKI Electric	Texas Instruments
Encore	Olivetti	Toshiba
FPS Computing	Omron	Unisys
Fujitsu	Phoenix Technologies	Wang
Fuji Xerox	Prime	Xerox

Software/Services Vendors		**Users**
Addamax	Micro Focus	Citibank
Cadence Design	Oracle	DuPont Fibers
CBIS	Prisma	Nippon Steel
CTG	Relational Technology	
HCR	SCO	
HCL America	Tolerant Software	
Informix	Topologix	
Interactive Systems	UniSoft	
Lachman Assoc.	88open	
Locus	Micro Focus	

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT IV-4

Profile: Open Software Foundation (OSF)

Founded:	May 1988
Location:	Cambridge, MA
Goals:	Based on member input, develop standard UNIX products
Technology Emphases:	Application/data base interface Operating system Advanced system extensions

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT IV-5

Open Software Foundation Members (As of June 1989)

Hardware Vendors

Altos	Groupe Bull*	Sequent
Apollo*	Hewlett-Packard*	Siemens*
Canon	Hitachi	Silicon Graphics
Computer Consoles	IBM*	Sony
Concurrent	Intel	Stratus
Convex	Intergraph	Sumitomo
Data General	MIPS	Texas Instruments
Dell	Nixdorf*	Toshiba
Digital Equipment*	Norsk Data	Wang
	Philips*	Xerox

Software/Services Vendors

Adobe	Micro Focus
Boeing Computer Services	Oracle
HCR Corporation	Relational Technology
Informix	Software AG
Lachman Associates	

* Sponsor company

For the more technical reader, Exhibit IV-6 lists four differences between UI and OSF. The following details better explain the first bullet:

- The OS kernels are preempted in different ways for real-time applications
- Different networking capabilities
- Different device drivers
- Different file systems
- Different security

Although each technical difference may be minor, as a group these differences drive the UNIX market apart rather than together. According to the "rumor mill," some founding members of OSF are actively working to implement UNIX International versions of products.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT IV-6

OSF Versus UI Differences

- Operating system kernels are restructured and significantly different
- Users protected if software implemented in standard manner
- Hardware vendors most affected by use of different operating system on proprietary platforms
- Other differences may result from X/Open support of multiple interface definitions for technologies

Since both UI and OSF are members, the pivotal organization in the UNIX market is X/Open Ltd. X/Open derives some of its clout by having a 19-member council of end users. Although this is a separate advisory council, rather than including end users on specific committees, the breadth of industries represented may provide a solid "sanity check" on vendor and software developer plans. Through X/Open, UI and OSF agreed in February 1989 on the Common Application Environment (CAE) standard. This agreement followed a vote by X/Open's user council to bring the two factions together.

X/Open's membership, listed in Exhibit IV-7, includes major European and Japanese computer systems vendors. All five computer manufacturer founding members are based in Europe. In addition, X/Open has more than 100 software vendor members worldwide.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT IV-7

Profile: X/Open Ltd.

Founded:	1984 (incorporated in September 1987)	
Locations:	Stamford, CT; San Francisco, CA; London; Tokyo	
Goal:	Define its "common applications environment" standard for UNIX systems	
Hardware Manufacturer Members:	IBM	Apollo
	DEC	Hitachi
	AT&T	NEC
	Sun	Prime
	Fujitsu	Nokia Data
	Hewlett-Packard	Olivetti*
	NCR	Philips
	Nixdorf*	Unisys
	Bull*	ICL*
	Siemens*	
Software Vendor Members:	More than 100 worldwide	
Other Members:	UNIX International; Open Software Foundation	
Verification Suite Testing Available from:	UniSoft Group (London; Boston; Emeryville, CA; Tokyo)	
Councils:	Independent Software Vendor (ISU) (16 members)	
	User Advisory Council (19 members)	

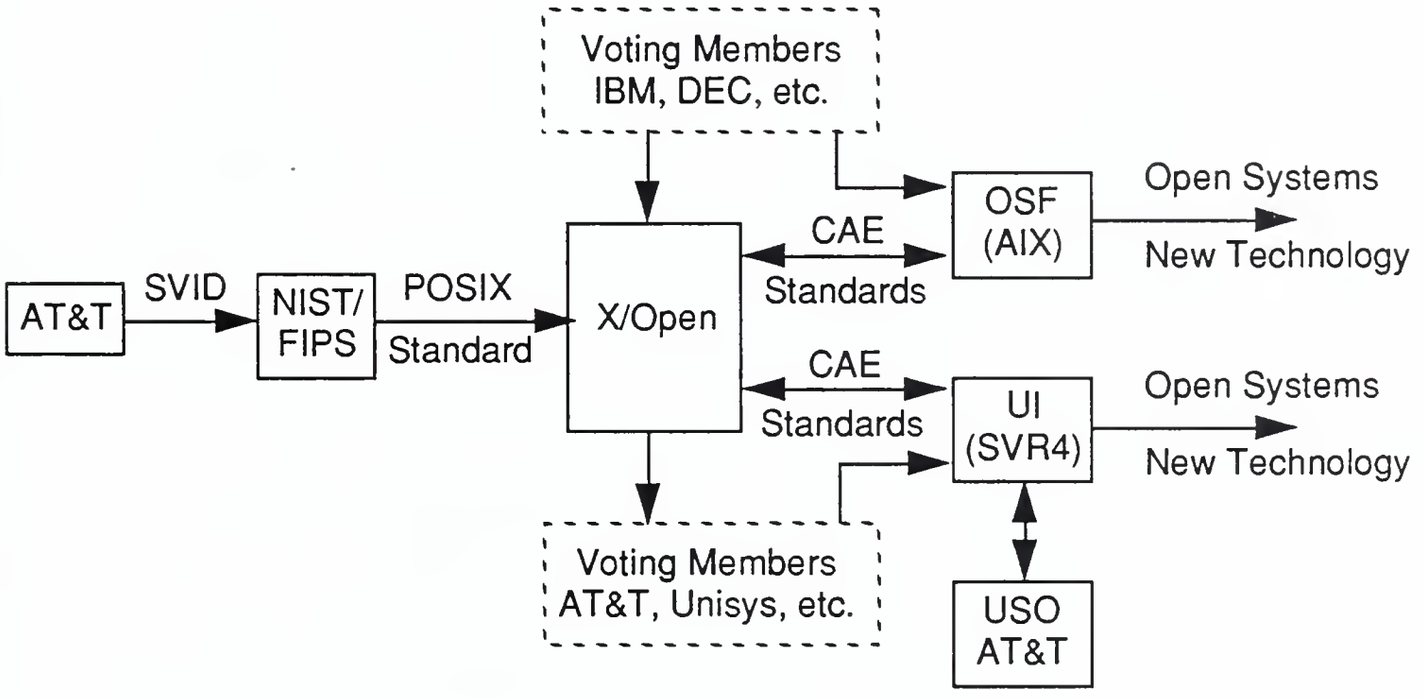
* Founding member

© 1989 by INPUT. Reproduction Prohibited.

The role of X/Open Ltd. in determining UNIX standards, depicted graphically in Exhibit IV-8, shows comprehensive involvement in the process. X/Open is working with OSF, UI, AT&T, and the federal government to resolve issues in common application environments (CAE) and the government's POSIX standard.

EXHIBIT IV-8

Current X/Open Standardization Efforts



Source: Cincinnati Bell Information Systems

This is an appropriate point to compare the standards offered by two primary industry groups and one major user—X/Open, OSF, and the federal government—for open software environments. Exhibit IV-9, from Digital Equipment Corporation, shows the following four areas of agreement:

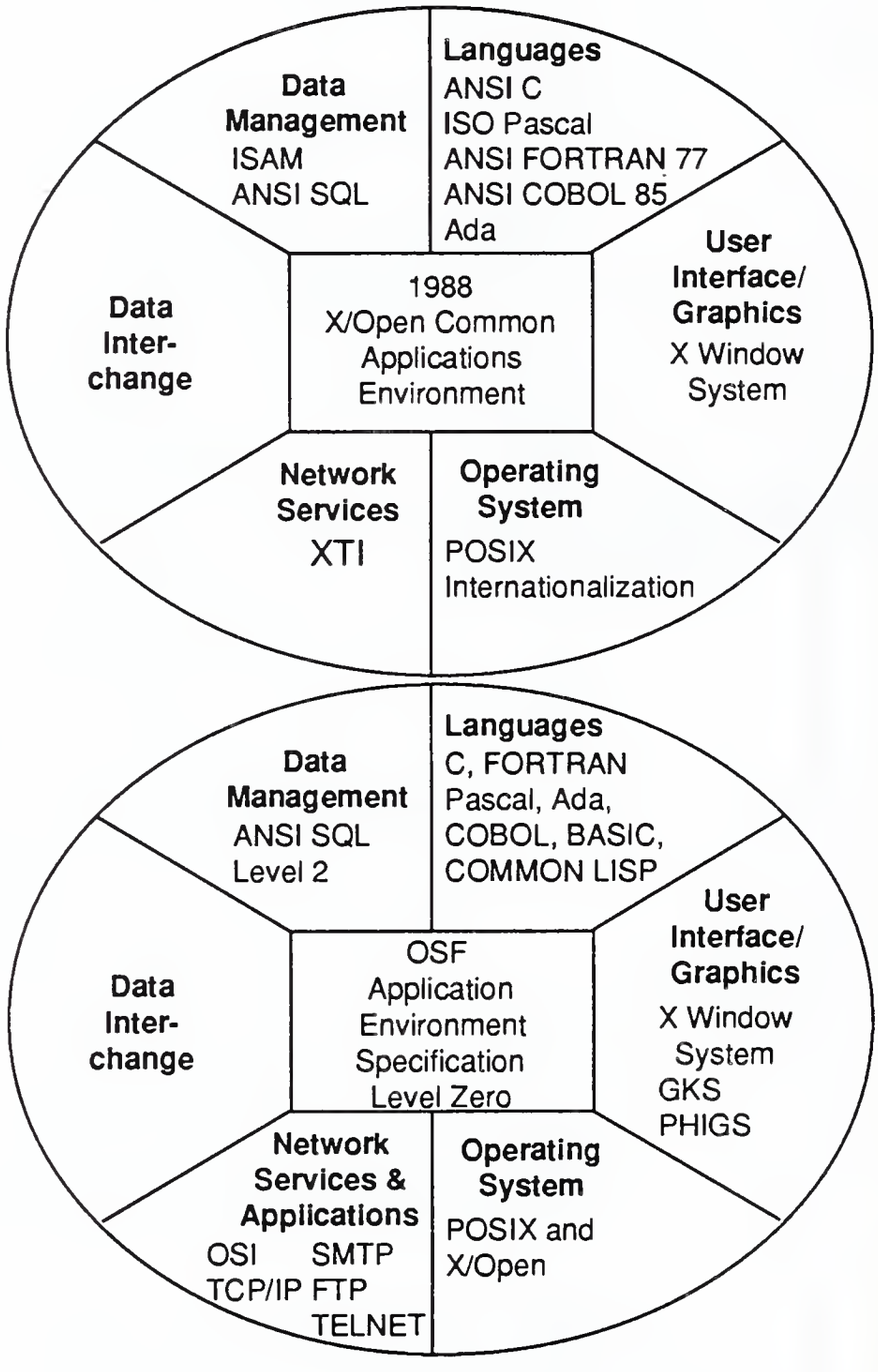
- Support for C, COBOL, Pascal, FORTRAN, and Ada higher languages
- Use of the X Window System graphical user interface
- The POSIX operating system specification
- Use of SQL for data management

While areas such as SQL, FORTRAN, and COBOL have been agreed to, the specific *version* of each data management tool or language has not been determined. A neutral solution would involve adopting ANSI standard versions of higher level languages.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT IV-9

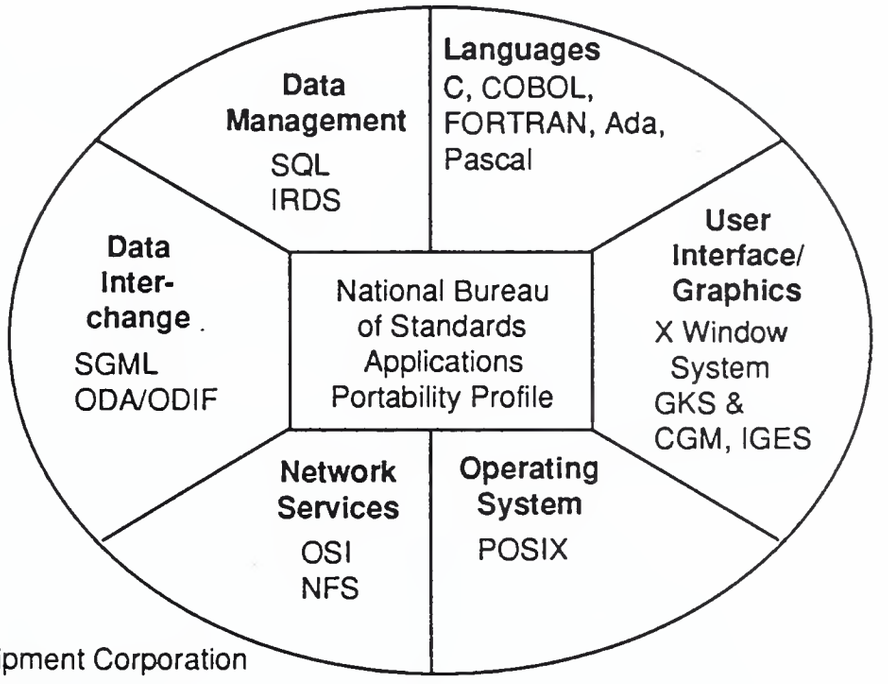
Comparison of Standards for Open Software Environments



© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT IV-9 (Cont.)

Comparison of Standards for Open Software Environments



Federal Government

Source: Digital Equipment Corporation

2. Secondary UNIX Industry Consortia

Three secondary groups—Open Desktop Group, Object Management Group, and Strategies for Open Systems—have emerged to influence specific aspects of the UNIX industry. Exhibits IV-10 and IV-11 contain organization information about the Open Desktop Group.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT IV-10

Profile: Open Desktop Group

Founded:	March 1989
Goal:	Create UNIX-based operating system
Features:	• 80386-based environment • Graphical user interface • Data base management system • Support TCP/IP and NFS communications
Primary Sponsors:	Santa Cruz Operation (Santa Cruz, CA) Tandy Corporation (Ft. Worth, TX) Locus Computing (Inglewood, CA) Relational Technology (Alameda, CA) Digital Equipment (Maynard, MA)

Open Desktop Group was started by Santa Cruz Operation, Tandy Corp, Locus Computing, Relational Technology, and Digital Equipment in early 1989 to create a separate UNIX-based operating environment for computers using the Intel 80386 microprocessor. These five vendors, each having a strong technical capability, banded together to:

- Create a guaranteed market for each vendor's products
- Get advanced products to market before Microsoft
- Provide outlets for products from UNIX-based application software vendors
- Obtain early commitments for UNIX distribution from software distributors and retail chain stores

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT IV-11

Organizations/Vendors Endorsing "Open Desktop" (Uniforum; San Francisco, CA; March 1989)

AT&T UNIX Software Operation	NCR Corporation
Acer Counterpoint Inc.	Open Software Foundation, Inc.
Arrow Electronics, Inc.	Olivetti PC Operations
Autodesk, Inc.	Performance Computing
CDI Computer Distribution	PGI Corporation
ComputerLand Corp.	P-STAT, Inc.
CSH Distributing	Quality Software Products
Century Software	Robec Distributors
Compaq Computer Corp.	Samna Corporation
Data General Corp.	Softsel Computer Products, Inc.
FourGen Software	Statware, Inc.
Fox Software, Inc.	Symantec Corporation
Frame Technology	Tandy Corporation/Radio Shack
Graphic Software Systems	3Com Corporation
Gupta Technologies, Inc.	TRG, Inc.
Hewlett-Packard Corp.	UNIFY Corporation
Infinite Solutions	Uniplex
Informix Software, Inc.	Unisys
Ingram Computer, Inc.	UNIX International
JSB Computer Systems Limited	Wang Laboratories
Language Processors Inc.	WordPerfect Corp.
Micro D	World-Wide Technology Inc.
Micro Focus	Wyse Technology
Microsoft Corporation	X/Open Company, Ltd.
NEC Information Systems, Inc.	Zenith Data Systems

The Object Management Group (OMG) was founded by Data General and other organizations to develop software based on object-oriented programming techniques. As shown in Exhibit IV-12, the Group's membership includes computer manufacturers, communications companies, an end user, and at least one software company.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT IV-12

Profile: Object Management Group

Founded:	April 1989	
Location:	Westboro, MA	
Goal:	Develop software based on object-oriented programming techniques (developed by founding member, Hewlett-Packard Company)	
Members:	Data General	Unisys
	Hewlett-Packard	Prime
	Canon	3Com
	Philips	Gold Hill Computers
	Sun	American Airlines
	AT&T	Netwise
	Borland International	

The OMG's early stage commitment to a developing technology makes it an interesting group. Rather than jockeying for competitive position, this consortium wants to further adoption of object-oriented programming techniques to enhance data base management applications. While not involved in the primary industry imbroglio, this group may be highly successful in garnering support for a new technology and establishing standards early on, rather than redesigning a 20-year-old product to meet divergent needs.

Another secondary UNIX consortium, Strategy for Open Systems (SOS) sponsored by the respected /usr/group, offers an educational approach to the UNIX market. By providing reference material, market information, user implementation case studies, and strategic planning guides (listed in Exhibit IV-13), SOS will likely affect future technical directions.

An important function of SOS is to ensure that vendors' newest technologies do not outrun users' abilities to become knowledgeable in and implement those technologies.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT IV-13

Profile: Strategies for Open Systems

Founded:	June 1989	
Locations:	Santa Clara, CA (/usr/group)	
Goal:	Provide reference information on open systems, including reports on issues, case studies on implementation, market trends, and strategic planning guide	
Charter Subscribers:	Open Software Foundation (OSF)	
	UNIX International (UI)	Hewlett-Packard
	X/Open	IBM
	Amdahl	Intel
	AT&T	NCR
	Bull	Prime
	Compaq	Sequent
	Data General	Texas Instruments
	DEC	Unisys
	Eastman Kodak	Wang

C

Organizations Focusing on UNIX Telecommunications

The following three industry groups focus on UNIX-based telecommunications products and services:

- Open Token Foundation
- Corporation for Open Systems
- OSI/Network Management Forum

The goal of the Open Token Foundation is to disseminate information on token ring technology-based interfaces. This group, described more fully in Exhibit IV-14, wants to offer a standards-based alternative to IBM's networks based on token ring technology.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT IV-14

Profile: Open Token Foundation

Founded:	December 1988	
Location:	Santa Clara, CA	
Goal:	To disseminate information on interfaces in order to encourage multivendor networking based on Token Ring technology (IEEE 802.5)	
Members:	Texas Instruments	Gateway Communications
	Western Digital	Synoptics Communications
	Proteon	Interlan
	NCR	Vitalink
	Network General	Madge Networks
	Microcom	

© 1989 by INPUT. Reproduction Prohibited.

The Corporation for Open Systems (COS), founded in 1985, was created to promote connectivity. Exhibit IV-15 indicates Open Systems Interconnection (OSI) and Integrated Services Digital Network (ISDN) technologies are the primary emphases. COS is driven mainly by the activities of AT&T and the Regional Bell Operating Companies (RBOCs), with support from federal government agencies and computer manufacturers with major stakes in the telecommunications market.

EXHIBIT IV-15

Profile: Corporation for Open Systems (COS)

Location: McLean, VA

Founded: 1985

Goals:
1. Foster communications connectivity
2. Promulgate OSI and ISDN
3. Develop conformance test products

Members:

Communications

AT&T Company	Northern Telecom Inc.
Bell Atlantic Corporation	Novell, Inc.
Bellcore	Pacific Bell
British Telecom/Dialcom Inc.	Retix
Data Connection Limited	Southwestern Bell Telephone
Network Systems Corporation	Televerket Swedish Telecom
NYNEX Corporation	3Com Corporation

Semiconductors

Intel Corporation	National Semiconductor Corp.
Motorola, Inc.	Texas Instruments Inc.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT IV-15 (Cont.)

Profile: Corporation for Open Systems (COS)

Members: (continued)

Computers & Software Technology

Amdahl Corporation
Apollo Computer Inc.
Apple Computer Inc.
Bull HN Information Systems Inc.
Concord Communications Inc.
Concurrent Computer Corp.
Control Data Corporation
Data General Corporation
Digital Equipment Corporation
GSI-Danet Inc.
Hewlett-Packard Company
Honeywell Inc.
Hughes LAN Systems
IBM Corporation
IDACOM
International Computers Ltd.
NCR Corporation
Prime Computer, Inc.
Soft-Switch Inc.
Sun Microsystems, Inc.
Tandem Computers Inc.
TECSIEL S.p.A.
Ungermann-Bass, Inc.
Unisys Corporation
Wang Laboratories, Inc.

Government

CCTA, Her Majesty's Treasury, British Government
National Communications Systems
National Institute of Standards and Technology
U.S. Air Force Communication Computer Integration Office
U.S. Army
U.S. Defense Communications Agency
U.S. Naval Data Automation Command

Open Systems Interconnection has sponsored one group, Network Management Forum, in an attempt to establish a single specification for OSI network management and to promote products conforming to its 7-layer OSI networking model.

OSI/NMF members, listed in Exhibit IV-16, include COS and the Standards Promotion and Application Group to ensure broad-based support for the OSI standard.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT IV-16

Profile: OSI/Network Management Forum

Founded:	June 1989
Goals:	1. Establish a single specification for OSI network management 2. Promote development of products conforming to 7-layer open systems interconnection (OSI) model
Members:	Corporation for Open Systems (COS) Standards Promotion and Applications Group (SPAG) OSI Network Management Forum (OSI/NMF)
Representative Member Companies:	Hewlett-Packard; Northern Telecom (COS) IBM; DEC (SPAG) AT&T; Unisys (OSI/NMF) British Telecom ICL

D

Organizations Focusing on RISC-Based Processor Architectures

Reduced Instruction Set Computing (RISC) is hot! RISC is based on the principle that 80% of a computer's work is done with 20% of the instructions. Although it may take some additional instructions to do the remaining 20% of the work, the processor runs all instructions rapidly, resulting in faster overall processing time. RISC computing, begun by workstation and minicomputer manufacturers, has spread rapidly since it is less costly to implement than designing a new generation of microprocessors.

Exhibit IV-17 shows three of the leading organizations promoting RISC computing. Motorola and Sun, through their respective lobbying organizations, are aggressively promoting their processor products.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT IV-17

UNIX Organizations Focusing on RISC Architecture

Organization	Processor
88open Consortium Ltd.	Motorola 88000
SPARC International	Sun Microsystems SPARC
Synthesis Software	MIPS Computer Systems RISC Processor

MIPS Computer Systems is taking a slightly different approach. MIPS is selling chip sets and systems to third parties while simultaneously using a separate company, Synthesis Software, to line up third-party vendors of application and system software.

Sun, which licensed its chip designs to at least five semiconductor manufacturers, is promoting its SPARC architecture through SPARC International. SPARC International, described in Exhibit IV-18, is covering the SPARC product from chip level through systems and application software.

EXHIBIT IV-18a

Profile: SPARC International (SI)

Founded:	February 1989
Location:	Sunnyvale, CA
Goals:	1. Ensure necessary hardware and software to build SPARC systems 2. Publish binary compatibility specifications 3. Direct evolution of SPARC architecture 4. Support third-party software vendors 5. Provide demonstration center for SPARC products

© 1989 by INPUT. Reproduction Prohibited.

Although somewhat early in the cycle, SPARC International appears to be more of a mutual admiration society than a solid foundation for marketing Sun's architecture. While Sun offers strong products, such as its Network Filing System (NFS), the need does not seem well established for vendors to rush to Sun. Other than second tier firms needing new products to sell, INPUT expects few first-tier vendors to embrace Sun's architecture. Many alternatives exist, standards issues are not sufficiently resolved, distribution of application software is not established, and service and support requirements are not well enough understood to warrant vendor commitment.

EXHIBIT IV-18b

Profile: SPARC International (continued)

Sponsor:	SPARC Vendor Council	
SI Founders:	Bipolar Integrated Technology Fujitsu Microelectronics LSI Logic Cypress Semiconductor Texas Instruments	
Members:	ARIX AT&T Definicon Fujitsu ICL Metaflow MIZAR N.V. Philips Prisma Ready Systems	Seiko Solbourne Sun Texas Instruments Unisol Unisys Valid Logic Wind River Systems Xerox
Distributors:	Software - Interactive Systems Corp. (Santa Monica, CA) Hardware - Phoenix Technologies (Norwood, MA)	

© 1989 by INPUT. Reproduction Prohibited.

The 88open Consortium Ltd, detailed in Exhibits IV-19 and IV-20, supports the Motorola 88000 family of RISC microprocessors. Its goal, of course, is to promote the 88000 family of Motorola products.

EXHIBIT IV-19

Profile: 88open Consortium Ltd.

Founded:	April 1988
Location:	Wilsonville, OR
Goal:	To establish and promote industry-wide adoption of open standards for Motorola 88000 RISC architecture-based products
Programs:	• Binary compatibility standard (AT&T System V, Rel. 3.0) • Object compatibility standard • Embedded systems committee • Peripheral support chips committee • Software initiative division
Supports:	X/Open

Note system software vendor commitment to the 88open Consortium. Although the group is about one-and-a-half years old, a number of system software vendors with solid technical expertise have joined. So have a half dozen major hardware vendors including Data General, Stratus, Convergent, Encore, Tektronix, NCR, and Icon International. Once again, this may be a means to lock in a loyal cadre of computer hardware, system software, and application software vendors to ensure that sufficient product and distribution channel muscle exists to enable this market to continue.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT IV-20

88open Consortium Ltd. Members

Corporate Members:	Absoft Corp. (Auburn Hills, Michigan) Altech (Sunnyvale, California) Applied Logic Systems (Syracuse, New York) Convergent Technologies (San Jose, California) Data General (Westboro, Massachusetts) Diab Data Inc. (Foster City, California) Edinburgh Portable Compilers (Edinburgh, Scotland) Encore Computer (Marlborough, Massachusetts) LM Ericsson (Stockholm, Sweden) Green Hills Software, Inc. (Glendale, California) Icon International (Orem, UT) Incremental Systems Corp. (Pittsburgh, Pennsylvania) Insignia Solutions (Sunnyvale, California) Integrated Micro Products, Ltd. (Consett, U.K.) Jet Propulsion Laboratories (Pasadena, California) Language Processors, Inc. (Framingham, Massachusetts) Motorola Microprocessor Products (Austin, Texas) NCR Corp. (Dayton, Ohio) Oasys (Waltham, Massachusetts) Omron Tateisi Electronics (Kyoto, Japan) Opus Systems (Cupertino, California) Phoenix Technologies Ltd. (Norwood, Massachusetts) Quotron Systems (Los Angeles, California) Ready Systems (Sunnyvale, California) Relational Technology (Alameda, California) Software Components Group (Santa Clara, California) Stratus Computer (Marlborough, Massachusetts) Tadpole Technology, Inc. (Cambridge, U.K.) Tektronix, Inc. (Wilsonville, Oregon) Unisoft Corp. (Emeryville, California)
Software Initiative Members:	Data General Motorola NCR Sanyo/Icon Dolphin Server Technology (Division of Norsk Data, Oslo) Opus Systems (Cupertino, California) Tadpole Technology (Cambridge, U.K.; Dublin, CA)

© 1989 by INPUT. Reproduction Prohibited.

A refreshing approach to RISC and high-performance computing involves formation of a neutral body for testing the performance of computer systems. The System Performance Evaluation Cooperative (SPEC), launched in November 1988, is outlined in Exhibit IV-21. Under the sponsorship of *Electronic Engineering Times* (Manhasset, NY), vendors of high-performance computers can get objective benchmarks done on their systems. This organization will enable users to make more informed choices of systems. Founding and member computer vendors should be applauded for this forward-looking action.

EXHIBIT IV-21

Profile: System Performance Evaluation Cooperative (SPEC)

Founded:	November 1988
Location:	Santa Clara, CA
Goal:	Provide objective tests for RISC and other high-performance computers to evaluate performance
Sponsor:	Electronic Engineering Times (Manhasset, NY)
Members:	Hewlett-Packard/Apollo* MIPS Computer* Sun Microsystems* Data General DEC Motorola (Microcomputer Division) Multiflow Stellar IBM

* Indicates founder

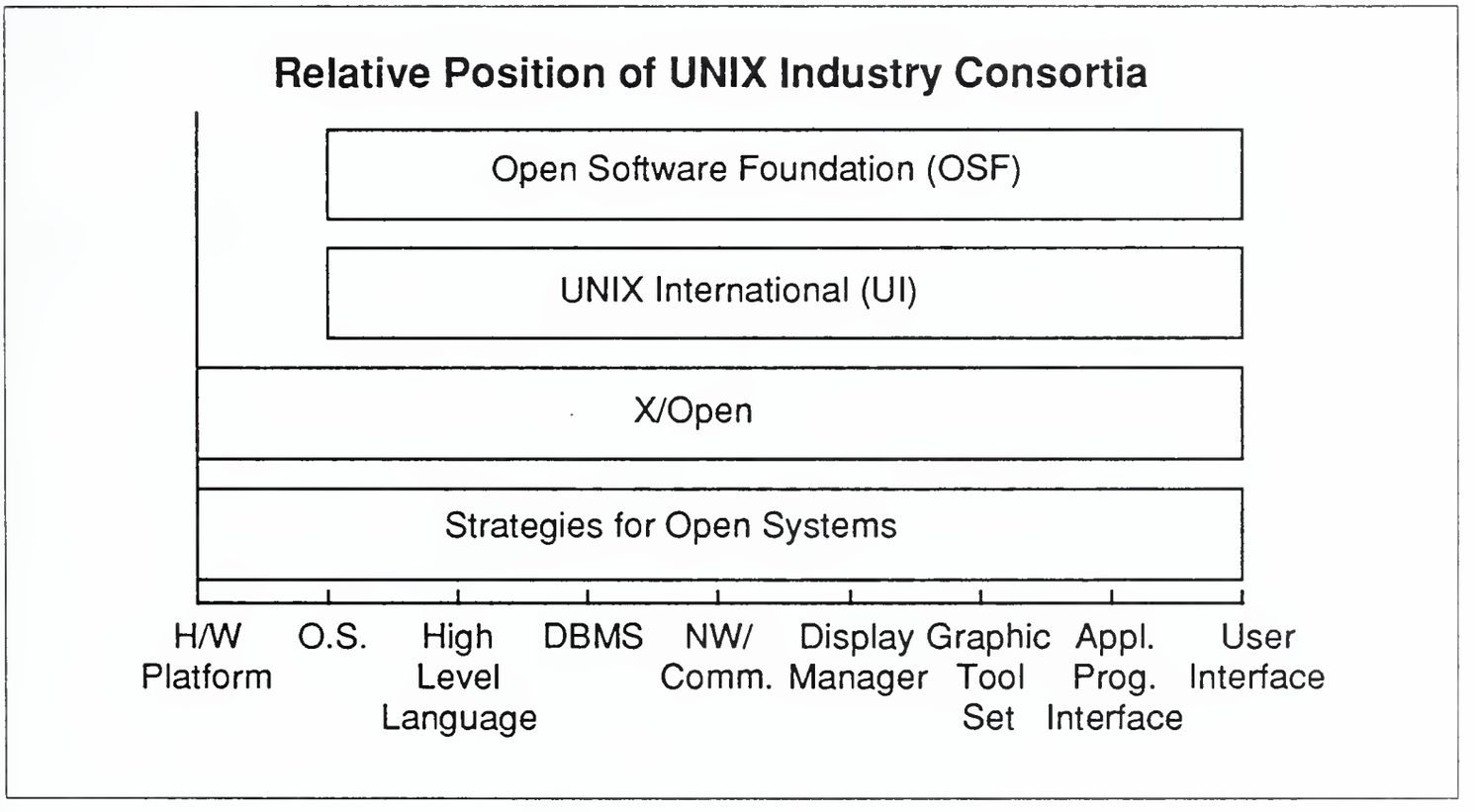
© 1989 by INPUT. Reproduction Prohibited.

E

Summary of UNIX Lobbying Organizations

Despite the hoopla about the advantages of UNIX, the industry, in late 1989, remains disorganized and inconsistent. The lack of consistency can be traced to the often conflicting aims of the various industry lobbying organizations. Exhibit IV-22 shows the relative positioning of the various UNIX industry consortia against the software-oriented UNIX market model (discussed in Chapter III).

EXHIBIT IV-22a



When diagrammed, it becomes clear that UI and OSF focus mainly on standards for operating systems, data base management products, and user interfaces. They are not influential in the areas of application programs, application program interface, networking, higher-level languages, or hardware platforms.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT IV-22b

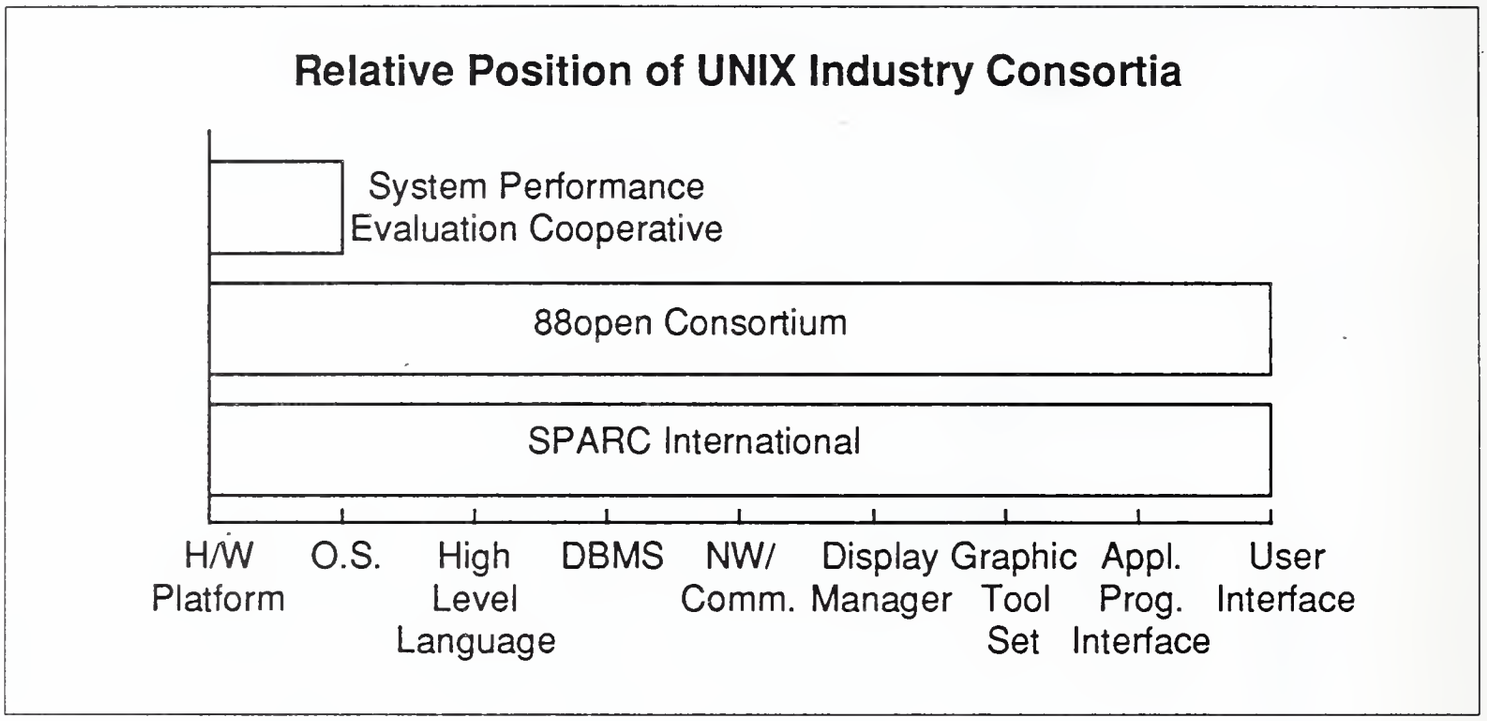
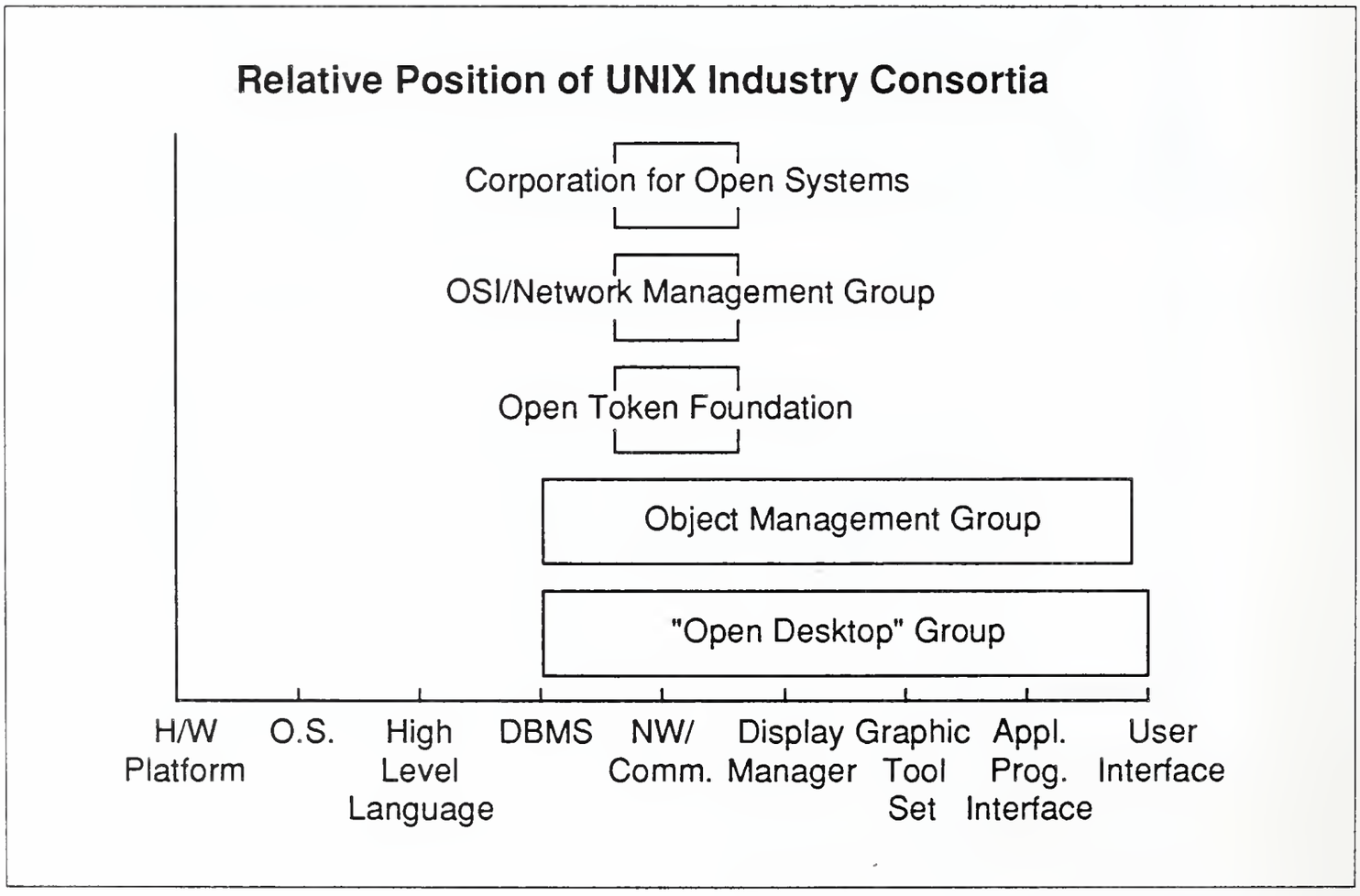


EXHIBIT IV-22c



© 1989 by INPUT. Reproduction Prohibited.

Like UI and OSF, the activities for X/Open Ltd. and Strategies for Open Systems (SOS) extend across the spectrum of UNIX software. Unlike UI and OSF, X/Open and SOS activities include the hardware platform, creating the broadest possible interface. Furthermore, UI and OSF belong to X/Open and Strategies for Open Systems, thereby enhancing the indirect power of each organization. It is hoped that, while UI and OSF are covered by the news media, the important negotiations, handled by X/Open and SOS, are resolving some of the differences.

F

Role of RISC-Based Architectures in UNIX

Section D (above) addressed the various RISC-based lobbying organizations in the UNIX market. This section focuses on the vendors of RISC-based processors and their marketing efforts. Exhibit IV-23 lists leading computer systems manufacturers which sell or license internally developed technology to other computer system manufacturers.

EXHIBIT IV-23

Leading Vendors of RISC-Based Processors

Company	Product	Number of Third-Party Chipmakers	Computer System Manufacturers
MIPS	RISCompilers	3	Ardent, MIPS, Prime, Racal Redac, RC Computers, Rolm Mil-Spec, NEC, Seiko, Silicon Graphics, Sony, Sumitomo, Tandem, TIS
Sun	SPARC	4	ARIX, AT&T, ICL, Sun, Unisys, Xerox, Daratech Enterprises (Taiwan), Tatung Co. (Taiwan), Toshiba

Computer system vendors Sun Microsystems and MIPS Computer Systems compete intensely in the RISC market battle. As of publication, Sun has more third-party semiconductor manufacturers licensing the technology than MIPS. However, MIPS has signed one more computer system vendor for its technology than has Sun. Both firms have signed major customers—MIPS signed Prime, ROLM Mil-Spec, and Tandem; Sun signed AT&T, Unisys, and Xerox.

© 1989 by INPUT. Reproduction Prohibited.

The RISC processor battle extends far beyond the influence of MIPS and Sun. Exhibit IV-24 lists other leading vendors of RISC-based systems, primarily marketed internally, rather than licensed externally. Hewlett-Packard, following the merger with Apollo, has embarked on an aggressive campaign to license its RISC technology to vendors. IBM prefers to maintain control of the technology, concentrating on alliances with vendors of application software and related peripheral technologies to deliver complete solutions to customers in vertical markets. Likewise, Intergraph has lined up third-party software vendors for its Clipper RISC technology, purchased from Fairchild Semiconductor Corporation, which began the development work.

EXHIBIT IV-24

Other Important Vendors of RISC-Based Processors

Company	Product(s)	Computer System Manufacturer Licensees
Apollo	Prism	Apollo
Hewlett-Packard	9000	Hewlett-Packard; Hitachi
IBM	RT	IBM
Intergraph	Clipper	Intergraph; Philips

Semiconductor manufacturers represent an important role in the development and marketing of RISC technology. Extending its SPARC technology is an important tenet of Sun's marketing philosophy. To this end, three of the five "chip houses" listed in Exhibit IV-25 have licensed Sun's SPARC technology. Advanced Micro Devices (AMD) and Motorola are also promoting their technologies. Leveraging its installed base of 880X0 processor-based systems, Motorola has been more successful in lining up manufacturers to use its 88000 family of RISC processors.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT IV-25

RISC Technology Licensing by Semiconductor Manufacturers

Semiconductor Manufacturer	Product(s)	Licensees
Cypress	SPARC	Not Available
Texas Instruments	SPARC	Phoenix Technologies*
Fujitsu	SPARC	Interactive Systems Corp.*
Advanced Micro Devices	29000	Not Available
Motorola	88000	Data General, Tektronix, Stratus
Intel	i860	Olivetti, Stratus, Prime

* System software vendor

G

UNIX Strategies of Leading Hardware Manufacturers

1. Introduction

This section includes summaries of the strategies of leading hardware manufacturers, a necessary step to better understand future UNIX market directions.

UNIX strategies for the following hardware vendors are presented:

Mainframes
- IBM
- National Advanced Systems
- Amdahl

Mid-range systems
- Hewlett-Packard
- The Ultimate Corporation
- Nixdorf
- Unisys
- Digital Equipment

© 1989 by INPUT. Reproduction Prohibited.

Workstations/Personal Computers
- Sun Microsystems
- IBM
- Apple

2. Mainframe Vendors

This section examines UNIX strategies for the following mainframe vendors:

- IBM
- National Advanced Systems
- Amdahl

IBM announced AIX/370, its implementation of UNIX for mainframes. As indicated in Exhibit IV-26, AIX/370 will play a clear secondary role in the IBM world, since IBM aggressively promotes its proprietary mainframe operating systems.

EXHIBIT IV-26

UNIX Strategy: IBM (Mainframe)

Product Name:	AIX/370
Importance of UNIX:	Secondary Operating System
Target Users:	Select accounts using UNIX, generally in combined scientific/technical/commercial applications
Target Industries:	All

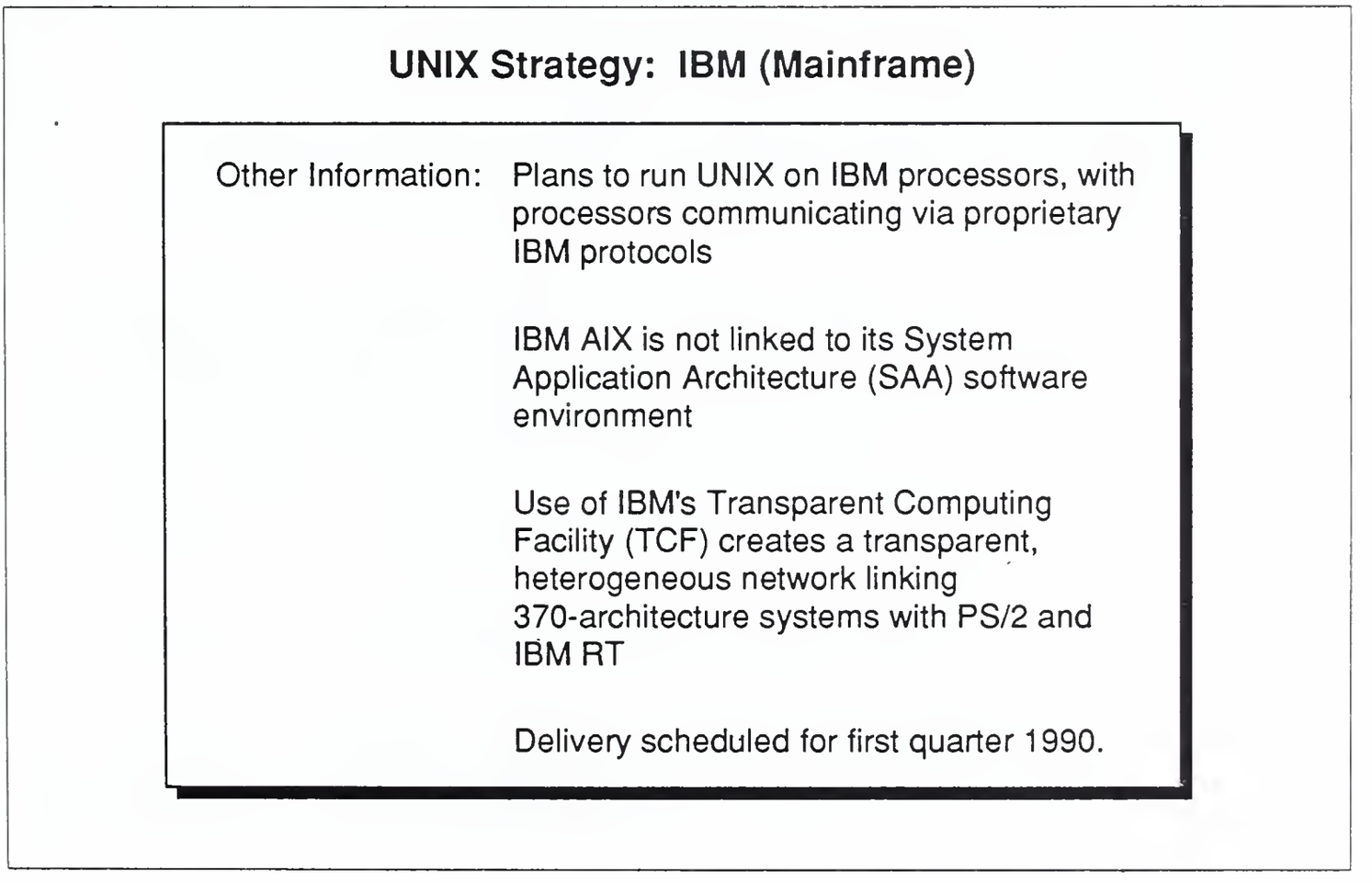
© 1989 by INPUT. Reproduction Prohibited.

A question remains as to whether AIX/370 will run in native mode or atop a proprietary operating system such as MVS/VM or MVS/XA. AIX/370, scheduled for release in the first quarter of 1990, is *not* linked with IBM's System Application Architecture, mentioned in Exhibit IV-27. AIX also depends on processors having a virtual machine environment, an enhancement which runs on all IBM hardware except 80386-based machines.

SNA and OfficeVision modules may be necessary with AIX/370 in order to provide full functionality. While professing support of open architectures, IBM nevertheless requires its customers to license proprietary products.

To take full advantage of UNIX, IBM will require that customers license an unreleased product, Transparent Computing Facility (TCF), in order to create a heterogeneous network. Using TCF, users will access a network that looks like a single computer and connects 370-architecture mainframes with PS/2 personal computers and IBM RT workstations. TCF is currently in beta test, running in native mode on a 3090 mainframe at a Silicon Valley firm.

EXHIBIT IV-27


UNIX Strategy: IBM (Mainframe)
Other Information:
Plans to run UNIX on IBM processors, with processors communicating via proprietary IBM protocols
IBM AIX is not linked to its System Application Architecture (SAA) software environment
Use of IBM's Transparent Computing Facility (TCF) creates a transparent, heterogeneous network linking 370-architecture systems with PS/2 and IBM RT
Delivery scheduled for first quarter 1990.

© 1989 by INPUT. Reproduction Prohibited.

National Advanced Systems (NAS), the former mainframe operation of National Semiconductor sold recently to Hitachi and General Motors' Electronic Data Systems (EDS) subsidiary, faces an entirely different problem from IBM. Exhibit IV-28 indicates NAS ceased joint development of a mainframe version of Sun Microsystems' SunOS operating system, opting to internally develop its version of AIX/370, IBM's implementation of UNIX System V.

EXHIBIT IV-28

UNIX Strategy: National Advanced Systems (NAS)

Product Name:	Unknown
Importance of UNIX:	Secondary operating system
UNIX Development:	1. Temporarily ceased joint development of mainframe version of Sun Microsystems' SunOS 2. Internally developing a version of AIX, IBM's version of UNIX

NAS adopting Sun's operating system would have been a tremendous coup. Making it easier for users to migrate to a relatively standard operating system with experienced users, focused on the mainframe area, was a great idea. However, two key influences likely derailed the plan.

First, any major modification to the kernel of the UNIX operating system creates a bottomless pit, one requiring more money to shore up.

Second, unpredictable finances in the semiconductor side of the business delayed development efforts.

Through its UTS implementation of UNIX, Amdahl has quietly met important needs of its customers in telecommunications, finance, and the federal government. Amdahl has supported UTS for more than 10 years,

© 1989 by INPUT. Reproduction Prohibited.

enhancing it to keep up with AT&T's System V. As indicated in Exhibit IV-29, UTS has become the company's primary operating system, a move to differentiate Amdahl from IBM. Amdahl has focused its marketing efforts on current minicomputer users of UNIX, enabling them to migrate applications to more powerful mainframes.

EXHIBIT IV-29

UNIX Strategy: Amdahl Corporation

Product Name:	UTS
Importance of UNIX:	Primary operating system
Target Users:	Existing users of UNIX on minicomputers, moving up to mainframes
Target Industries:	Telecommunications, finance, federal government
Other Information:	Amdahl is positioning itself as a "solutions vendor"

3. Mid-range Systems Vendors

This section examines UNIX strategies for the following mid-range systems vendors:

- Hewlett-Packard
- The Ultimate Corporation
- Nixdorf
- Unisys
- Digital Equipment

With its focus on the mid-range, Hewlett-Packard is placed in a quandary regarding UNIX. For technical systems, HP's HP-UX implementation of UNIX is clearly the primary operating system. In commercial environments, UNIX is secondary.

© 1989 by INPUT. Reproduction Prohibited.

As indicated in Exhibit IV-30, HP sells UNIX to those environments running applications independent of hardware. Furthermore, HP's marketing efforts are focused on four major industries for direct sales, while using a variety of third parties to reach other vertical markets.

EXHIBIT IV-30

UNIX Strategy: Hewlett-Packard (Mid-Range Systems)

Product Name:	HP-UX
Importance of UNIX:	Technical environment: primary operating system Commercial environment: secondary operating system
Target Users:	Commercial and technical users requiring applications running independent of hardware
Target Industries:	Manufacturing, banking and finance, services, federal government

HP's work with 800 independent software vendors and value-added resellers to develop programs running under UNIX shows its commitment to open systems. Further, as shown in Exhibit IV-31, HP is working on parallel processor versions of its RISC technology to improve hardware price/ performance.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT IV-31

UNIX Strategy: Hewlett-Packard (Mid-Range Systems)

Other Information:	Commercial acceptance of HP-UX increased in 1988
	HP has 800 independent software vendors and value-added resellers developing programs under HP-UX
	HP is working on parallel processing versions of its RISC-based processors

The Ultimate Corporation (East Hanover, NJ) had been successful in selling minicomputer-based systems running the Pick operating system. To rebuild some lost momentum, Ultimate is moving toward open systems, thus adopting UNIX. UNIX will enable Ultimate to resell the IBM RT, Bull HN Information Systems hardware, and DEC VAX minicomputers. As shown in Exhibit IV-32, Ultimate plans to keep the DBMS portion of Pick, adding a UNIX user interface, communications, and application software.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT IV-32

UNIX Strategy: The Ultimate Corporation (Mid-Range Systems)

Importance of UNIX:	Secondary operating system, moving to shared primary operating system (with PICK)
UNIX Source:	VMark Software (Natick, MA) is licensing its universe UNIX derivative program, which lets PICK software run under UNIX
Hardware Supported:	IBM RT Bull H.N. Info Systems 1700 DEC VAX
Other Information:	Ultimate plans to retain the DBMS portion of PICK, then add the UNIX user interface, communications capabilities, and base of application software

Nixdorf Computer, a strong second-tier player, is positioning its mid-range systems around UNIX. Nixdorf will continue to focus on the manufacturing and retail distribution vertical markets (see Exhibit IV-33). The company's systems will represent a growth path for current UNIX users in the $50-200 million revenue range.

In its mid-range systems, Unisys Corporation is adopting open systems in order to unify disparate, pre-merger product lines from Burroughs and Univac. Although, according to factors shown in Exhibit IV-34, this unification is necessary, the timing should work to Unisys' favor. The company has marketed UNIX-based commercial systems for a few years, relying on UNIX vendors Sequent, Arix, and Computer Consoles for systems until its Convergent subsidiary builds production capacity.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT IV-33

UNIX Strategy: Nixdorf Computer Corporation (Mid-Range Systems)

Importance of UNIX:	Primary operating system for mid-range computers
Target Users:	Fortune 1000; companies with revenues of $50-$200 million
Target Industries:	Manufacturing; retail distribution
Other Information:	AT&T System V versions of UNIX account for 90% of total UNIX shipments, compared to 10% for Berkeley versions

EXHIBIT IV-34

UNIX Strategy: Unisys (Mid-Range Systems)

UNIX-Based Processors Supplied by:	Sequent Computer Systems ARIX Corporation Computer Consoles Convergent
Importance of UNIX:	Primary operating system for mid-range processors (necessary to unify disparate product lines from Burroughs and Univac)
Target Users:	End users in the industries listed below
Target Industries:	Retail distribution, state and local government, telecommunications, airlines

© 1989 by INPUT. Reproduction Prohibited.

For Digital Equipment, UNIX (through its Ultrix/32 implementation) is a secondary operating system. Although Digital prefers to license its proprietary VAX/VMS operating system, the company has supported Ultrix for at least seven years on VAX, its popular minicomputer line. As indicated in Exhibits IV-35 and IV-36, UNIX may move to a near-equal position with Digital's VAX/VMS, due to the needs of key customer segments—system integrators, software developers, value-added resellers, and telecommunication companies.

EXHIBIT IV-35

UNIX Strategy: Digital Equipment (Mid-Range Systems)

Product Name:	Ultrix/32
Importance of UNIX:	Secondary operating system
Target Users:	Software developers, system integrators, value-added resellers
Target Industries:	Higher education, manufacturing, banking and finance, federal government, utilities, medical

INPUT expects Digital to enhance its Ultrix operating system by adding support for real-time and transaction processing environments. This will be necessary to meet the needs of existing customers and to differentiate Digital from other purveyors of open systems.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT IV-36

UNIX Strategy: Digital Equipment (Mid-Range Systems)

Other Information:	Has shipped UNIX-based systems to the telecommunications industry since 1969
	Expected to provide enhancements to UNIX such as support for real-time and transaction processing in order to differentiate its products and company

4. Workstations/Personal Computers

This section evaluates UNIX strategies for the following workstation/ personal computer vendors:

- Sun Microsystems
- IBM
- Apple

In a nutshell, "Sun Microsystems equals UNIX" or "UNIX equals Sun Microsystems." SunOS, the company's UNIX implementation, is Sun's primary operating system. Based on the clever and timely idea of using existing standards, Sun made it easier for users to migrate to its products than to other UNIX-based systems. The company has focused on the five markets listed in Exhibit IV-37, selling to technical or commercial users—in short, anyone wanting a high performance general purpose workstation.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT IV-37

UNIX Strategy: Sun Microsystems

Product Name:	SunOS
UNIX Importance:	Primary operating system
Target Users:	Technical users, commercial users, software developers, system integrators
Target Industries:	Higher education, manufacturing (autos, aerospace, electronics), federal government, banking and finance
Other Information:	Sun shipped a secure version of its operating system (Sun OSMLS) in July 1989

At the July 1989 press conference where Sun and Lotus announced a joint development effort (presumably for Lotus 1-2-3), Sun also announced a "five phase" plan for UNIX workstations. Exhibit IV-38 includes the key tenets of Sun's plan.

Following the steps outlined in Sun's plan, it is clear that this plan is a broad brush stroke campaign to align supporters for its SPARC architecture. While it is straightforward, the plan could fall short at one of the five stages indicated, especially stages 3 and 4. There is clearly a limited number of vendors wanting to adopt (and support!) another architecture, no matter how robust and powerful.

Current industry mythology indicates that users buy Sun's workstations on the basis of price/performance. In fact, the wide range of application software is what sells Sun workstations. For the company to remain successful, it must make some investments in select third-party application software vendors and pay to port software for new applications to its hardware. No longer can the company assume that software vendors will port to its machines simply because they are "hot boxes."

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT IV-38

Sun Microsystems' "Five Phase" Plan for UNIX Workstations

1. Encourage vendors to build binary compatible instruction set chips
2. Increase number of licenses for its operating system
3. Work with hardware vendors to build UNIX-compatible SPARC architecture workstations
4. Encourage key software developers to port to UNIX/Open Look
5. Ship SPARC-compatible systems in volume

In the microcomputer area, IBM has announced AIX (a UNIX implementation) for its PS/2 line of high performance microcomputers. Given the past close working relationship of IBM and Microsoft, IBM is offering AIX simply to round out its product line (see Exhibit IV-39). However,

EXHIBIT IV-39

UNIX Strategy: IBM (Personal Computers)

Product Name:	AIX PS/2
Importance of UNIX:	Secondary operating system
Target Users:	System integrators, value-added resellers
Target Industries:	All

© 1989 by INPUT. Reproduction Prohibited.

AIX does not support IBM's SAA or SNA architectures, thereby strongly limiting its appeal to existing IBM customers. New customers are not as likely to select AIX for IBM systems, when they can choose AT&T UNIX which runs on many other vendors' systems.

For Apple, its A/UX UNIX product is clearly positioned as a secondary operating system, according to the information given in Exhibit IV-40. Similar to some IBM mainframe environments, Apple expects users to license its Macintosh operating system, then run UNIX on top of this. By this scheme, offering UNIX simply gives users the common UNIX user interface (whatever that turns out to be) while running applications under either UNIX or Macintosh.

EXHIBIT IV-40

UNIX Strategy: Apple Computer

Product Name:	A/UX
Importance of UNIX:	Secondary operating system
Target UNIX Markets:	System integrators, value-added resellers
Target Industries:	Education and federal government
Other Information:	Apple wants UNIX to represent a user interface, running application software similar to the Macintosh environment, as well as running Macintosh programs Apple introduced a secure version of A/UX (CMW) in May 1989, targeted for the federal government

© 1989 by INPUT. Reproduction Prohibited.

5. Summary of Computer Hardware Vendors' UNIX Strategies

For the 9 vendors analyzed, UNIX is not consistently positioned, as is indicated in Exhibit IV-41. Rather, the importance of UNIX depends on each computer hardware vendor's:

- Success with a proprietary operating system
- Ability to attract third-party application software
- Target markets
- Target users

EXHIBIT IV-41

Summary of Hardware Vendors' UNIX Strategies

Vendors	UNIX Position		Target Users				Target Markets				
	Primary	Secondary	Software Devel.	Tech.	Commercial	SI	Education	Manufacturing	Government	Bank/Finance	Other
Sun	X		X	X	X	X	X	X	X	X	
DEC		X	X			X	X	X	X	X	X
Unisys	X(1)										X
IBM Mainframe		X			X	X	X	X	X	X	X
Amdahl	X								X	X	X
HP		(2)			X			X	X	X	X
Nixdorf		(1)						X			X
IBM Microcomputers		X					X	X	X	X	X
Apple		X(2)				X	X		X		
IBM Mid-range		X			X	X		X	X	X	X

(1) For mid-range processors
(2) Primary operating system in technical environments; secondary operating system in commercial environments

© 1989 by INPUT. Reproduction Prohibited.

H

UNIX Strategies of Leading System Software Vendors

1. Introduction

This section examines UNIX strategies of the following operating system software vendors:

- AT&T
- Microsoft
- The Santa Cruz Operation
- Mt. Xinu

2. UNIX Strategies

As the developer and marketer of the original UNIX, AT&T has made tremendous strides in improving the operating system and enhancing its functionality. AT&T must continue to gain the support of semiconductor manufacturers, application software developers, system software companies (especially those with application development tools for the UNIX environment), and hardware vendors (see Exhibit IV-42).

EXHIBIT IV-42

UNIX Strategy: AT&T

Subsidiary:	UNIX Software Division
Locations:	Summit, NJ; Greensboro, NC
UNIX Strategy:	As the original developer and marketer, gain support for UNIX from: • Semiconductor manufacturers • Vendors of application development tools • Hardware vendors not currently running UNIX Work with select vendors having strong technical capabilities to execute enhancements suggested by UNIX International (Enhancements may include: transaction processing, fault tolerance, real time, multiprocessor operations, and support for foreign languages)

© 1989 by INPUT. Reproduction Prohibited.

INPUT expects AT&T to further enhance UNIX by supporting additional features such as:

- Transaction processing
- Fault-tolerant computing
- Real-time environments

Microsoft, the licensing and development organization for the MS-DOS microcomputer operating system, is expected to embrace UNIX in a limited way (see Exhibit IV-43). Recent company information on its experience in the microcomputer market indicates some slowing of demand for personal computers, plus a growing concern that users may not adopt its new OS/2 operating system to the extent previously believed. More users are aware of OS/2's significant shortcomings, specifically:

- It was developed on systems running Intel's 80286, not the 80386, microprocessor
- OS/2 does not support multi-tasking
- OS/2 is not a multi-user operating system

EXHIBIT IV-43

UNIX Strategy: Microsoft Corporation

Location:	Bellevue, WA
UNIX Strategy:	Lessen corporate dependence on IBM DOS and OS/2
	Leverage existing product distribution, support, and publishing capabilities
	Development work will be done by Santa Cruz Operation, with Microsoft having first chance to distribute
	Pressure leading hardware vendors to ensure UNIX is ported to their hardware platforms

© 1989 by INPUT. Reproduction Prohibited.

INPUT expects Microsoft to exert some pressure on microcomputer manufacturers to offer UNIX as a secondary operating system on their hardware. Microsoft could add substantial muscle to Santa Cruz Operation's distribution activities, also leveraging its 20% investment.

In a related manner, The Santa Cruz Operation is hedging its bets by working with Microsoft on products which combine UNIX and OS/2, notably LAN Manager/PMX. SCO will continue to follow the lead for UNIX standards set by UI and OSF. However, the company has seized a major opportunity in the early life cycle of 80386-based microcomputers by creating the Open Desktop environment. Open Desktop includes support from at least 25 application and system software vendors (please see Exhibit IV-44).

EXHIBIT IV-44

UNIX Strategy: The Santa Cruz Operation

Location:	Santa Cruz, CA
Investor:	Microsoft Corporation (20%)
UNIX Strategy:	Will follow the UNIX standards: • AT&T System V, Release 4.0 • UNIX International and OSF GUIs Believes OS/2 and UNIX will coexist, so working with Microsoft on LAN manager/PMX Due to SCO's large installed base of SCO/XENIX, the company is creating, through "Open Desktop," its own UNIX-based operating system/environment featuring select RDBMSs, communication protocols, and graphical user interfaces for 80386-based machines. SCO has support from at least 25 application/system software vendors for its System V/386 product
Key Investor:	Microsoft Corporation (20%)

© 1989 by INPUT. Reproduction Prohibited.

Building on its success in the DEC VAX market, Mt. Xinu is working with Carnegie Mellon University (Pittsburgh, PA) to develop a commercial version of the Mach operating system, designed for use in multiprocessor UNIX environments. Mt. Xinu's experience with Digital and Sun hardware indicate likely targets for porting Mach. According to the information in Exhibit IV-45, Mt. Xinu will commercialize products developed at Carnegie Mellon, including Camelot (a transaction processing support system) and Andrew (a UNIX tool kit and file system).

EXHIBIT IV-45

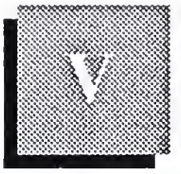
UNIX Strategy: Mt. Xinu

Location:	Berkeley, CA
UNIX Strategy:	Focus on Mach operating system, which it is developing under guidance of DARPA and Carnegie Mellon University
	Port Mach operating system to DEC MicroVAX, Sun-3, and IBM RT workstations
	Add X Windows, Camelot (transaction processing), UNIX 4.3, and Andrew (tool kit and file system)

© 1989 by INPUT. Reproduction Prohibited.

© 1989 by INPUT. Reproduction Prohibited.

Related UNIX Environments



Related UNIX Environments

This chapter explores activities related to the UNIX operating system, including:

- Operating system enhancements
- Graphical user interface software
- UNIX-based RDBMS software
- UNIX-based application development tools
- UNIX-based image processing systems

A Other UNIX-Based Operating Systems

By no means is UNIX a single, monolithic operating system. Vendors have added various "flavors" to AT&T's vanilla UNIX to come up with systems optimized for different computing environments, including:

- Fault-tolerant
- Real-time

1. Secure Versions of UNIX

Exhibit V-1 lists two vendors supporting the newest version of AT&T UNIX plus six other vendors offering mainly "secure" versions of UNIX. An interesting phenomenon is the formation of a group working on a multiprocessor version of AT&T System V Release 4.0. AT&T, Intel Scientific Computers, Olivetti and OKI will offer minicomputers with multiprocessor architectures, given that multiprocessor architectures enable the vendors to retain their existing customers while moving to substantially higher system performance levels.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT V-1

New UNIX-Derivative Operating Systems

Operating System	Vendor(s) Involved	Details
System V Release 3.2	Interactive Systems Corp.	Merges UNIX with XENIX
System V Release 3.2	Santa Cruz Operation	Merges UNIX with XENIX
Mach	Mt. Xinu	Commercial version of Mach operating system
CX/SX	Harris Corporation	Offers "B-1" level of system security
Unnamed	Intel; AT&T; Prime Computer; Olivetti; OKI;Unisys/ Convergent	Multiprocessing version of System V Release 4.0, running on INTEL microprocessors
UTX32	Gould/Encore	Offers "B-1" level of system security
SunOS MILS	Sun	Offers "B-1" level of system security
A/UX (CMW)	Apple	Secure version of A/UX operating system
Ready Systems	VRTX32	Real-time operating system, running on SPARC architecture

2. Fault-Tolerant Versions of UNIX

Fault-tolerant UNIX software is expected to grow rapidly from a base of less than $10 million in 1989. Three vendors listed in Exhibit V-2, which are attacking this market, include Integrated Micro Products, Tolerant Software, and Olivetti/Stratus.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT V-2

Vendors of Fault-Tolerant UNIX Software

Vendor	Product	Processor(s)
Integrated Micro Products (formerly Parallel Computers) (Santa Cruz, CA)	FT/UX	Parallel Systems
Tolerant Software, Inc. (San Jose, CA)	Eternity	Tolerant Systems
Olivetti; Stratus Computer (Ivrea, Italy; Marlboro, MA)	Unnamed	Stratus & IBM System/88

Tolerant Software, a recent spinoff from Tolerant Systems, is focused on licensing its fault-tolerant enhancements and utilities hardware vendors whose systems run UNIX System V Release 4.0. Tolerant management is targeting open systems and multi-vendor network computing environments.

Stratus' Western Region Development Lab in Saratoga, CA announced support for the UNIX operating system. It is logical that Stratus is collaborating with investor Olivetti to develop enhanced UNIX software, focusing on international markets.

3. Real-Time Versions of UNIX

Vendors of real-time versions of UNIX span the minicomputer and microcomputer markets. Exhibit V-3 lists eight vendors offering real-time or near real-time solutions in UNIX. Alcyon, VenturCom, Interactive Systems, DIAB Systems, and Lynx target the personal computer/workstation market. Concurrent, Alliant, and Modcomp, based on proprietary minicomputers, target the mid-range market.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT V-3

Vendors of UNIX-Based Real-Time Computer Systems

Vendor	City/State	Operating System(s)
Alcyon	San Diego, CA	Regulus
Alliant Computer Systems	Littleton, MA	FX/RT
Concurrent	Westford, MA	RTU
DIAB Systems	Foster City, CA	D-NIX
Integrated Solutions	San Jose, CA	Vx Works Plus
Interactive Systems	Santa Monica, CA	386/ix
Lynx Real-Time Systems	Campbell, CA	LynxOS
Modular Computer Systems	Ft. Lauderdale, FL	Real/IX
VenturCom	Cambridge, MA	VENIX/386; 386/ix

B

Other UNIX System Software Products

Other UNIX system software products include:

- Graphical user interfaces
- Relational data base management systems (RDBMSs)

1. Graphical User Interface (GUI)

A key area for differentiation is graphical user interfaces (GUIs), the screens that users see. GUIs spare users from having to deal with powerful, though arcane, UNIX commands. Leading hardware vendors, listed in Exhibit V-4 and generally experienced in UNIX, offer proprietary GUI products.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT V-4

A Sample of UNIX-Based Graphical User Interface (GUI) Products from Hardware Vendors

Vendor	Product(s)
Digital Equipment	DECWindows
Hewlett-Packard	New Wave
Metaphor Computer Systems	Metaphor
Microsoft/Hewlett-Packard	Common X Interfaces
NeXT	NeXT Step
Sun Microsystems	Open Windows
Wang Laboratories	Freestyle

Hardware vendors are not the only ones offering GUI software. INPUT identified seven third-party vendors (listed in Exhibit V-5) which offer GUI software running on multiple hardware platforms. Revenues in 1988 for the leading vendor, VI Corporation, were about $15 million. VI has licensed its interface products to many of the leading minicomputer and workstation vendors. Other key players include TeleLOGIC, IXI Limited, and Torch Technology.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT V-5

A Sample of UNIX-Based Graphical User Interface Products from Third-Party Software Vendors

Vendor	GUI Product(s)	CPUs Supported
Gfx Base (Milpitas, CA)	Color X11	Commodore Amiga
IXI Limited (Cambridge, England)	X.desktop	BiiN Corporation; Sun; Apollo, HP 9000, NCR, Acorn/Olivetti
Paragon Imaging (Lowell, MA)	Visualization Workbench	DEC VAXstation 3100
TeleLOGIC AB (Linkoping, Sweden)	TeleUSE	UNIX-based systems
Torch Technology Ltd. (Cambridge, England)	X-Sun	Sun
Unicad (Norfolk, VA)	X-Pression	DEC VAXStation 3200, Sun-3, Apollo
V.I. Corporation (Amherst, MA)	DataViews	Apollo, H-P, DEC, IBM RT, Masscomp, Sun, Silicon Graphics

The second Xhibition trade show focusing on MIT's X/Window technology was held in June 1989 in San Jose, CA. The first Xhibition, held in an MIT gymnasium, attracted about 300 attendees, while nearly 3,000 persons attended the most recent show. An important indicator is the ratio of suits to "propellor-heads," increased by a factor of nearly ten, indicating more commercial interest in the X/Window environment. Exhibit V-6 lists the 52 vendors which had booths at the show.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT V-6

Vendors Exhibiting at Xhibition '89 (June 1989; San Jose, CA)

Advanced Graphic Engineering	Meta Software Corporation
Adobe Systems	Microfield Graphics
Advanced Tech Center	NCR
Apple Computer	Network Computing Devices
ASP, Inc.	Network General
AT&T	Neuron Data
Cabletron	Non-Standard Logic
Control Systems	O'Reilly & Associates
CrossWind Technologies	Paragon Imaging, Inc.
DeLorme Mapping	Parallax Graphics, Inc.
Digital Equipment Corporation	Prentice Hall
Digital Press	Prime Computer
Elan Computer Group	Saber Software
Frame Technology	Santa Cruz Operations
Graphic Software Systems	Sequent Computer Systems
GfxBase	Sony Microsystems
GraphOn	Sun Microsystems
Hewlett-Packard	Systine Computer, Ltd.
Human Designed Systems	Tektronix
IBM	TeleLOGIC
Integrated Computer Solutions	Torch Computers, Ltd.
Integrated Inference Machines	Unicad
Interactive Systems Corporation	UNIX World
IXI, Ltd.	Visix Software
Jupiter Systems	Visual Technology
Matrox Systems	White Pine Software

© 1989 by INPUT. Reproduction Prohibited.

Firms selling the following types of UNIX products exhibited at the show:

- Software development tools
- Computer systems
- Publishers of UNIX books
- Professional services firms offering UNIX education and training
- Turnkey system

From Xhibition, Exhibit V-7 lists four vendors of UNIX-based turnkey systems. Application areas include mapping, video production/image processing, network-based display stations, and industrial process control.

EXHIBIT V-7

Applications at XHibition '89
Integrating X/Window User Interface

Application	Vendor/Location
Computer mapping systems	DeLorme Mapping Co. Freeport, Maine
Industrial process control	Group GTIE Notre-Dame-De-Gravenchon, France
Network-based display stations	Network Computing Devices Mountain View, CA
Video production/ image processing	Sony Microsystems Palo Alto, CA

Two important graphical user interfaces, "Open Look" and "OSF/Motif," are based on MIT's X/Window technology. While the first conference to preview vendor implementations, it was of great interest to see which approach was more widely used. From the summary in Exhibit V-8, it is clear that OSF/Motif is the early winner in the GUI sweepstakes.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT V-8

Open Look versus OSF/Motif at Xhibition '89 (June 1989; San Jose, CA)

- Open Look
  - Sun
  - AT&T
  - NCR
- OSF/Motif (15-20 vendors, including:)
  - HP
  - DEC
  - IPL
  - TeleLOGIC
  - Santa Cruz Operation

Out of fairness, more vendors belonging to OSF than UI (at the time) attended. One would therefore expect more hardware vendor implementations of OSF/Motif. What is unusual, however, was the number of third-party software vendor exhibitors showing OSF/Motif. The bottom line is: UI may have more members, but it appeared that OSF had better GUI technology (in June 1989), or possibly an easier technology to implement.

2. Relational Data Base Management Systems (RDBMSs)

UNIX-based relational data base management software is a topic of great interest to users and vendors. Exhibit V-9 contains the estimated UNIX-based RDBMS revenues for leading vendors. INPUT contacted the vendors listed or used secondary sources to estimate RDBMS revenues.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT V-9

Leading Vendors of UNIX-Based RDBMS Software

Vendor	Past 4 Quarters Total Company Revenues * ($ Millions)	Estimated UNIX RDBMS** Revenues ($ Millions)	Estimated UNIX RDBMS Revenues as a Percent of Co. Revenues
Information Builders	140.0	14	10
Informix	116.2	95	>80
Oracle	584.0	160	27
Relational Technology	130.7	98	75
Sybase	35.0	28	80
The Small Computer Company	7.0	4	60
Unify	30.0	10	33

* Through May/June 1989
** Worldwide

The top spot in UNIX RDBMS software is held by Oracle ($160 million) with Relational Technology ($98 million) and Informix ($95 million) closely behind. The other vendors listed have many years of UNIX experience and INPUT expects these vendors to take advantage of that experience.

For the UNIX application software market to grow, software vendors require extensive application development tools. Exhibit V-10 lists leading vendors of UNIX-based application development tools. Unify, with its Accell product line, has revenues nearly double those of the second-place vendor, Language Processors (acquired by Ryan McFarland/Austec). Revenues for other leading vendors are estimated in the $2-5 million range.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT V-10

Leading Vendors of UNIX-Based Application Development Tools

Company	Location	Estimated 1988 UNIX Application Development Tools Revenue ($ Millions)
HCR Corporation	Toronto, Canada	3
Language Processors/ Ryan McFarland/Austec	Framingham, MA	8
Micro Focus	London, U.K. and Palo Alto, CA	4
Unify	Sacramento, CA	15
Unisoft	Emeryville, CA	2

C

UNIX Application Software Products

One measure of relative interest in UNIX is the number of packages of application software available. Exhibits V-11 and V-12 list the number of UNIX-based horizontal and vertical market application software packages running under UNIX.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT V-11

Number of UNIX-Based Horizontal Application Software Packages

Horizontal Software	Number of Packages under UNIX
Accounting	297
Data Base Management	61
Graphics	81
Office Automation	133
Personnel	19
Sales & Customer Tracking	12
Spreadsheets	51
Word Processing/ Text Formatting	84
Total	738

Source: */usr/group 1988 UNIX Products Directory*

Horizontal applications such as word processing, accounting, and graphics account for nearly 740 packages compared to the 730 packages for vertical markets such as insurance, banking, and real estate. Admittedly, the absolute number of packages is not large. However, remember that the packages run on a variety of large, medium, and small hardware platforms, giving tremendous breadth to the software vendor's product line.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT V-12

Number of UNIX-Based Vertical Application Software Packages

Vertical Software	Number of Packages under UNIX
Advertising	4
Agriculture	2
Construction	45
Employment & Recruiting	13
Engineering	20
Financial Analysis	12
Government & School Admin.	24
Hotel/Property Management	8
Insurance	12
Inventory Control	39
Legal	28
Manufacturing/Distribution	202
Mathematical/Statistical	35
Medical/Dental	74
Membership Organizations	10
Nonprofit Groups	8
Petroleum	36
Project Management	28
Real Estate	26
Retail/Point-of-Sale	35
Sales & Marketing	7
Typesetting & Publications	44
Vehicle Management	17
Total	729

Source: */usr/group 1988 UNIX Products Directory*

© 1989 by INPUT. Reproduction Prohibited.

D

Turnkey UNIX-Based System Solutions

UNIX-based turnkey systems are being marketed. Exhibit V-13 highlights a new application, image processing systems. At least four vendors now offer UNIX-based image processing systems, running on a variety of hardware platforms from IBM RT to small proprietary systems to DEC VAX.

EXHIBIT V-13

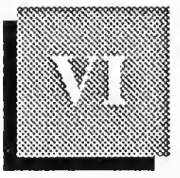
UNIX-Based Image Processing Systems

- ARIX/IMIX (Chantilly, VA)
- Candi Technology (Santa Clara, CA)
- Image Business Systems (New York, NY)
- Plexus/Recognition Equipment (Dallas, TX)

It is interesting that image processing systems combine a new operating system with new application software, with a high level of professional services, specifically software development/customization. Direct sales may not be sufficient to penetrate businesses used to handling paper in a certain way. Alliances with federal and commercial system integrators may be a necessary step for market acceptance.

© 1989 by INPUT. Reproduction Prohibited.

User and Software Vendor Requirements



User and Software Vendor Requirements

This chapter examines the needs within UNIX of end users and software vendors. The information presented is a distillation of what was learned through informal surveys of users and software developers.

A UNIX-Related User Requirements

1. Why Users Adopted UNIX

Users' reasons for adopting UNIX are indeed varied. As indicated in Exhibit VI-1, some are forward-looking, others are in response to changes by hardware vendors, while a third category of reasons includes "having UNIX thrust upon us."

EXHIBIT VI-1

Users: How We Selected UNIX

- The future is UNIX
- Changes in other operating systems
- Part of a turnkey solution
- Experimental approach

© 1989 by INPUT. Reproduction Prohibited.

Specific comments with a forward-looking focus include: "My boss said the future was going toward UNIX" and "UNIX was an experiment, since we had no external electronic mail."

In response to changes by hardware vendors, one respondent indicated "RM/COS was discontinued on the NCR Tower, so we went with UNIX, its replacement."

One user, who evidently would not have selected UNIX, stated "We were bullied into UNIX. It was sold as part of a package to run third-party manufacturing software."

In sum, there is no clear method for adopting UNIX. Based on responses to our survey, UNIX just happened, was promoted, and was pre-packaged.

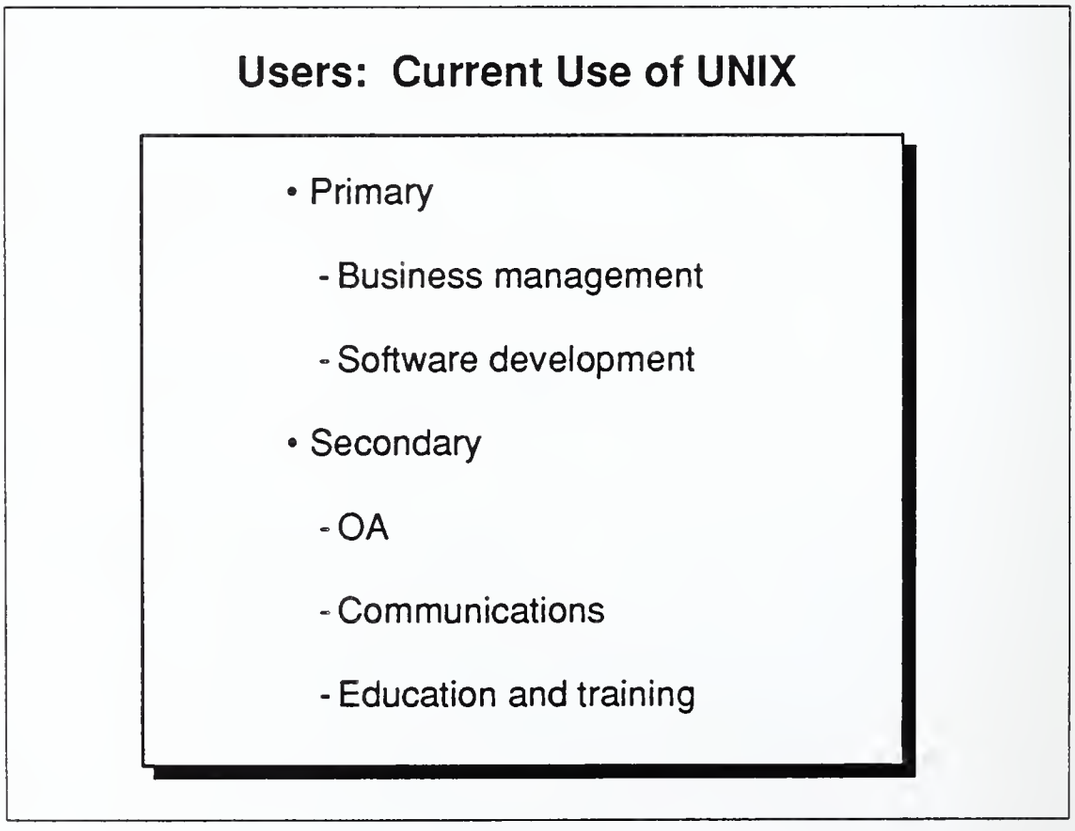
2. Current UNIX Usage

According to survey data, summarized in Exhibit VI-2, the two leading applications for UNIX are:

- Business management
- Software development

UNIX is also used in office automation, communications, and computer-related education and training, especially in colleges and universities.

EXHIBIT VI-2



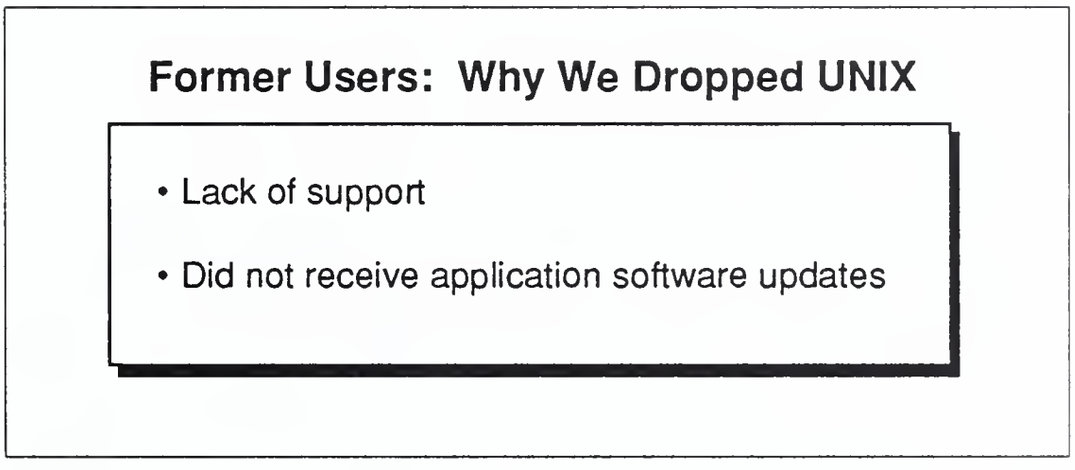
© 1989 by INPUT. Reproduction Prohibited.

Business management includes inventory, accounts payable, accounts receivable, and payroll, plus, in one instance, a system for tracking membership to an organization. Office automation included using local area networks (LANs) from Banyan and Novell.

3. Users' Reasons for Dropping UNIX

Users mentioned two primary reasons, listed in Exhibit VI-3, for dropping UNIX. Lack of support from the application software vendor, and not receiving product updates from the application software vendor are universal reasons for dropping *any* product or service, not specifically UNIX.

EXHIBIT VI-3



In these instances, users selected the following alternatives:

Using a Macintosh-based RDBMS, with applications developed in-house

Moving to an IBM PC-based system, then contacting a third-party software developer to complete the project

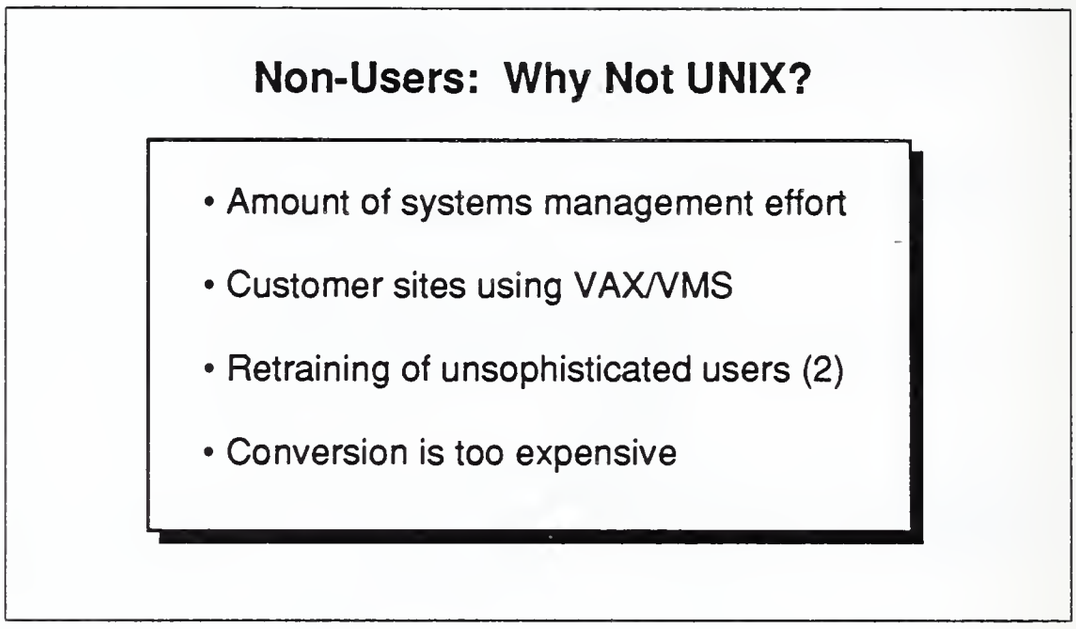
Keep in mind that these experiences did not represent the UNIX mainstream. However, these experiences point out the importance of good vendor support early in a new technology's life cycle. No matter how good or beneficial the product, poor support creates problems for all.

4. Non-Users' Reasons for Not Trying UNIX

In order to provide a different perspective, INPUT thought it would be interesting to examine why some organizations did not consider or adopt UNIX. "Retraining of unsophisticated users" was the main reason mentioned, indicated in Exhibit VI-4.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT VI-4


Non-Users: Why Not UNIX?
• Amount of systems management effort
• Customer sites using VAX/VMS
• Retraining of unsophisticated users (2)
• Conversion is too expensive

Two generic reasons were that one respondent's customers were using DEC VAX/VMS operating system, so they had to directly support those efforts. The other respondent indicated conversion would be too expensive. Once again, both reasons are not specific to UNIX.

One discrete manufacturing company offered a straightforward comment that "DEC's VMS takes very little managing, while UNIX requires more system management." Whether true or not, it is perceived that UNIX requires more manpower to maintain.

B

UNIX-Related Software Vendor Requirements

This section examines software vendors' reasons for selecting UNIX and current software development tools.

1. Why Software Vendors Chose UNIX

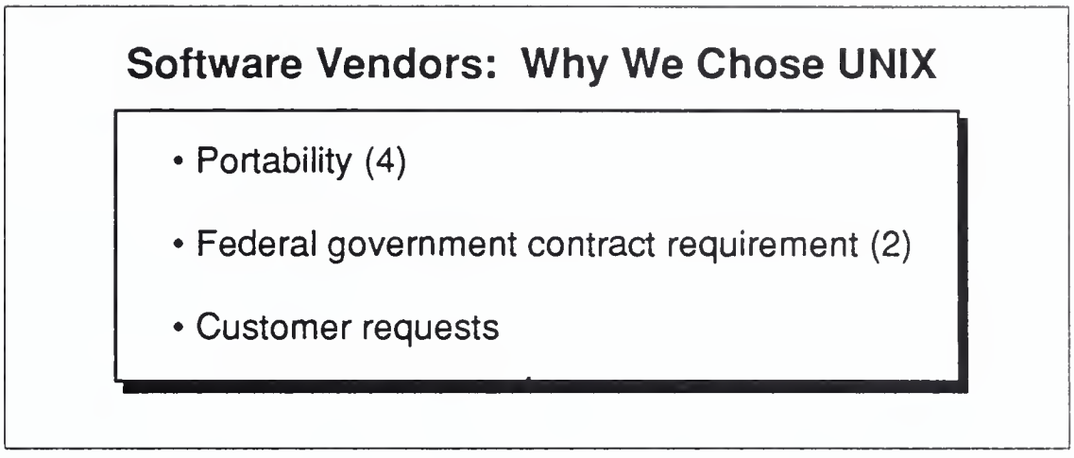
Software vendors selected UNIX for the reasons listed in Exhibit VI-5. The key reason, portability, was mentioned by twice as many vendors as the requirement for UNIX in federal government contracts, which was in second place.

The portability reason is obvious—software vendors want to leverage their code as much as possible, without creating a product and customer support nightmare. INPUT expected this to be the primary reason given by software vendors.

It is interesting that the requirement by the federal government for UNIX, which itself is a variant on customer requests, came in ahead of customer requests. The federal government has more clout with vendors than was assumed in the past.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT VI-5

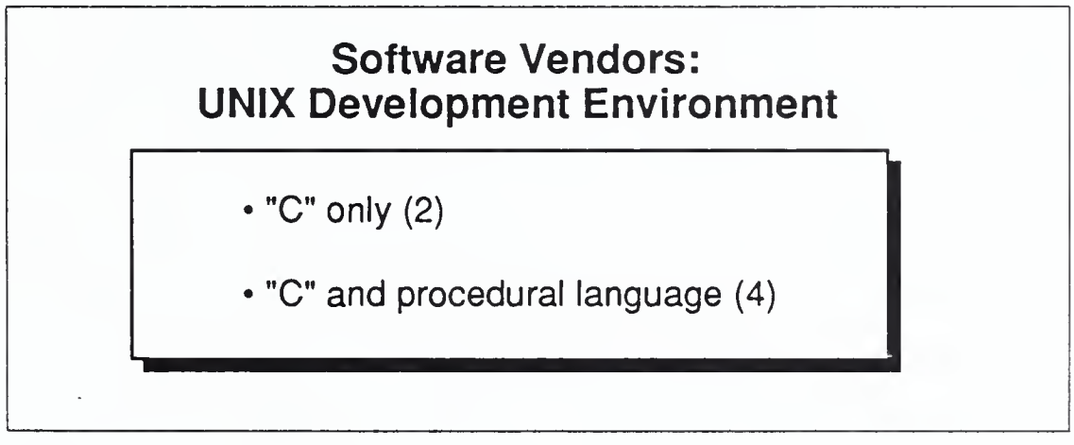


One software vendor's response on portability bears repeating. He stated, "In 1983, the choice in open systems software was between Pick and UNIX. We based our choice on portability and momentum of the operating system. We guessed UNIX (would be the better choice)." In this case, timing and limited choices yielded UNIX. In today's confusing system software environment, software vendors have fewer timing constraints, more choices, and increased dependence on fewer hardware vendors.

2. Software Vendors' Development Environment

A key question facing software developers is what development tools to use. Exhibit VI-6 presents information from INPUT's informal survey of software developers.

EXHIBIT VI-6



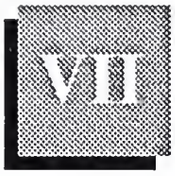
While "C" language is highly portable, fewer developers use it by itself than in combination with a procedural (or "fourth generation" language). Fourth generation languages (4GLs) are limited, since they cannot address complex RDBMS-based applications. In addition, current 4GLs cannot handle sophisticated user and programmer interface requirements. Therefore, the optimum solution is to use a combination of development tools.

© 1989 by INPUT. Reproduction Prohibited.

© 1989 by INPUT. Reproduction Prohibited.

VII

Conclusions, Opportunities, and Recommendations



Conclusions, Opportunities, & Recommendations

This chapter is divided into the following sections:

- Conclusions
- Vendor opportunities in UNIX
- User opportunities in UNIX
- Recommendations to UNIX software vendors
- Recommendations to UNIX users

A Conclusions

1. Conclusions About UNIX

The first conclusion, though heretofore unwritten, is: There are no simple conclusions about the UNIX market! Rather, it is preferable to talk about different segments or aspects of UNIX, as detailed in Exhibit VII-1.

Although much has been done to promote open standards, UNIX is not, at this time, a truly open system. Basically, either a system is open or it is not. The UI/OSF rift, plus the myriad of choices in data base management software, graphical user interfaces, networking/ communications, graphic tool sets, and application program interfaces result in substantially more permutations than existed before the industry adopted so-called standards!

Unfortunately, the current situation for software developers and users can be summarized in one word: confusion. Confusion leads to one important implication for software developers. Developers will wait until future directions become clearer before making a commitment to develop software for UNIX. Unfortunately, to be successful, UNIX needs to quickly develop critical mass, especially in commercial applications.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT VII-1

Conclusions

- While an open standard, UNIX is not, in late 1989, truly "open"
- UNIX strongest in minicomputers; fastest growth in PC/workstations
- Any graphical user interface will foster acceptance of UNIX
- More commercial applications are required for UNIX to be successful

UNIX' genesis was in the minicomputer market, where UNIX now represents 27% of cumulative systems shipped, versus shares of 7% in the personal computer/workstation market and 4% of cumulative mainframe shipments. Its fastest growth is in mainframes where, starting at a low level, annual UNIX licenses are expected to grow at a compound annual growth rate (CAGR) of 12% (versus 8% for workstations/PCs and 6% for minicomputers).

Why the concern in the UNIX industry about a graphical user interface? Apple Computer's Macintosh operating environment is the real driving force behind graphical user interfaces. What it boils down to is this: Due to the Mac's friendlier operating environment, IBM and UNIX vendors have lost sales in many instances. IBM and the UNIX community must move more quickly to remedy this deficiency.

2. Advantages of Using UNIX

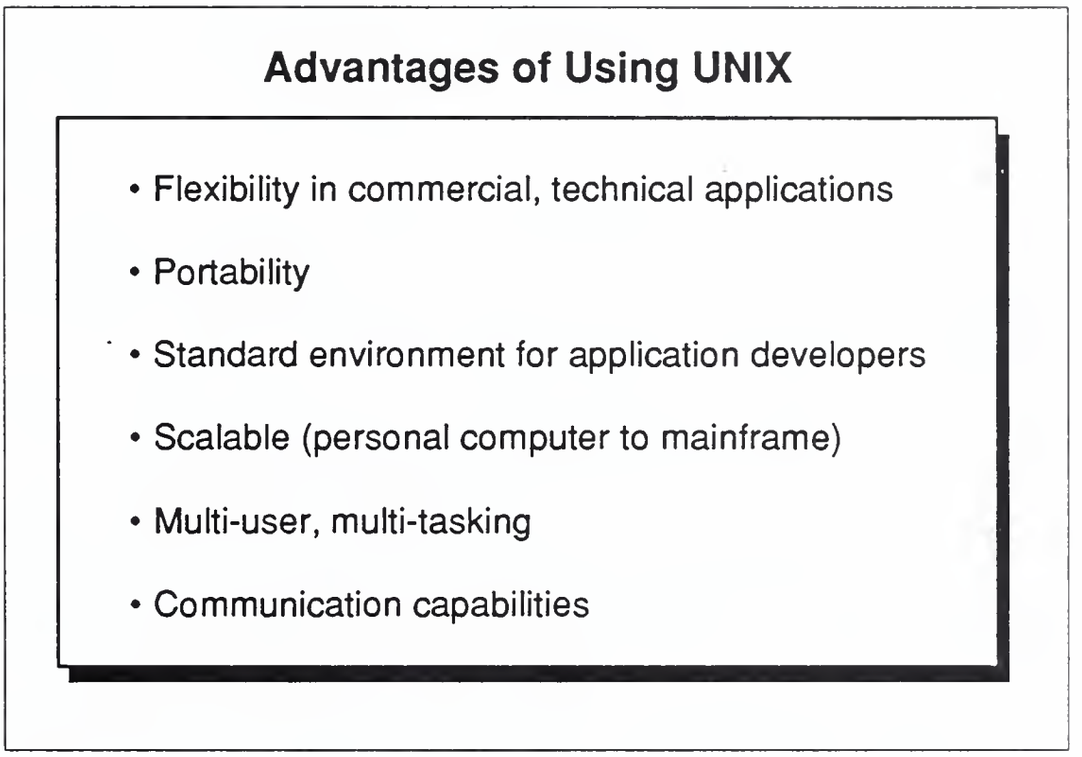
Exhibit VII-2 lists a number of advantages of using UNIX, gathered from interviews with vendors and users. A major part of UNIX' appeal is its:

- Portability, its ability to be moved from one computer system to another
- Scalability, or ability to run on personal computers, workstations, minicomputers, mainframes, and supercomputers

© 1989 by INPUT. Reproduction Prohibited.

- Multi-user environment, supporting more than a single user
- Multi-tasking support, the ability to simultaneously run more than one computer job, or task, at a time

EXHIBIT VII-2


Advantages of Using UNIX
• Flexibility in commercial, technical applications
• Portability
• Standard environment for application developers
• Scalable (personal computer to mainframe)
• Multi-user, multi-tasking
• Communication capabilities

Additionally, UNIX provides a standard environment for application developers, permitting maximum leverage from their efforts. Furthermore, using C language, customer support and product updates should be easier than in most proprietary operating environments.

Currently, UNIX offers the best support for computer systems designed around multiprocessor architectures.

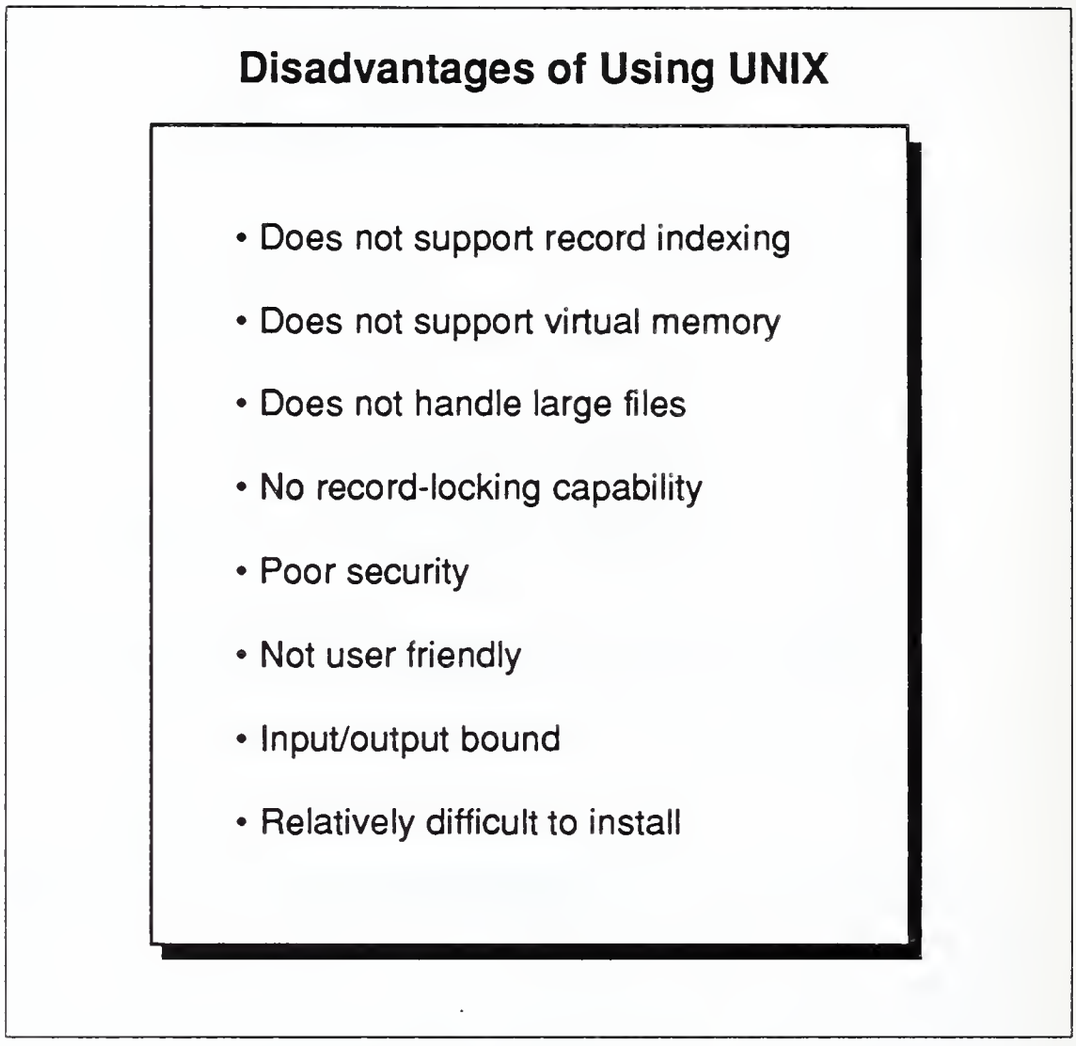
3. Disadvantages of Using UNIX

To balance the list of advantages of using UNIX, Exhibit VII-3 shows the disadvantages.

While nearly every disadvantage listed is of a technical nature, the net effect is that, relative to proprietary operating systems, UNIX has fairly major shortcomings at this time. Weaknesses such as lack of record indexing, no record locking, poor security, and being input/output-bound can be addressed in the short term.

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT VII-3


Disadvantages of Using UNIX
• Does not support record indexing
• Does not support virtual memory
• Does not handle large files
• No record-locking capability
• Poor security
• Not user friendly
• Input/output bound
• Relatively difficult to install

A longer-term problem is lack of support for virtual memory, surprising since nearly every minicomputer architecture now supports virtual memory. Software developers must also address the input/output limitation of UNIX in order to keep pace with advances in hardware architectures.

4. Barriers to Widespread Acceptance of UNIX

Based on conversations with users and developers, five key barriers remain before UNIX is more widely adopted. Among the barriers listed in Exhibit VII-4, the most serious is the lack of personal productivity software.

INPUT again emphasizes that the lack of spreadsheet, word processing, graphics, standard electronic mail, office automation, and industry-specific packages will delay true acceptance of UNIX.

Related keys to success include UNIX hardware and software integration. Hardware integration translates into the ability for one processor to communicate and share files with a second processor manufactured by a

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT VII-4

Barriers to Widespread Acceptance of UNIX

- Lack of personal productivity applications
- Integration of UNIX hardware
- Integration of UNIX software
- Distribution of UNIX software
- Requirements for service and support

different vendor. Software integration means an application-to-application linkage or the ability for one computer to run application software developed on a different computer without modification (also called "binary compatibility").

UNIX must also be more widely distributed. Users cannot be expected to: (1) Develop UNIX software internally or, (2) Contact a value-added reseller (VAR) for UNIX-based solutions. To be truly accepted, UNIX must be available at computer stores and software retailers.

This implies inherent capabilities for users to install the products and accomplish some level of self-training. The requirement that a third-party vendor or sophisticated end user install and maintain UNIX is hardly consistent with any product seeking broad market exposure.

B

Vendor Opportunities in UNIX

Despite a few significant negative factors, UNIX offers more opportunity for software and hardware vendors than any other operating system. Why?

First, UNIX is real. SAA, OfficeVision, Transparent Computing Facility, Compound Document Architecture, cooperative processing, and other concepts are largely just that—concepts, somewhat far from implementation.

Second, UNIX has momentum. UNIX may not be perfect, but users already see its advantages, especially in the longer term.

© 1989 by INPUT. Reproduction Prohibited.

A good place for vendors to begin is with office systems, especially applications for executive information systems, office automation, and text processing. UNIX' strength as a file server and its multi-user, multi-tasking capabilities should help establish a solid foundation.

Business application opportunities for vendors include integrated, modular, accounting; human resources, including payroll; and education and training. Microcomputer- and minicomputer-based software for applications establish UNIX at the core of small business applications.

Personal productivity is a logical target for UNIX vendors. It is surprising that a company such as Software Publishing Corporation (Mountain View, CA) has not ported its easy-to-use "pfs:Professional" series or "pfs:First Choice" product to UNIX. To build supporters for something new, why not modify easy-to-use existing products? Furthermore, SPC has a solid reputation for customer support. Symantec Corporation (Cupertino, CA) added expert systems capabilities to its products (which are similar in scope and functionality to those offered by Software Publishing). Further, Symantec appears a logical choice to help establish a UNIX application software beachhead. (Refer to Exhibit VII-5.)

C

User Opportunities in UNIX

This section on user opportunities might well be titled "Taking the First Steps with UNIX." The first two opportunities listed in Exhibit VII-6 represent UNIX strengths. The greatest challenge for UNIX vendors, then, may be building on these strengths to expose more end users to UNIX systems.

First, UNIX supports multi-user, multi-tasking applications. This is not to say that the support comes inexpensively, since the UNIX operating system kernel requires about 2MB of main memory. However, the newest 80386-based microcomputers and minicomputers can easily handle this kernel, supporting up to 15 or 20 users.

Users should also be aware of UNIX-based communication applications. Network communications under UNIX, especially TCP/IP and Ethernet, are stable environments, and work with many different computer systems.

At this time, it is fair to say that UNIX offers users only limited independence from hardware vendors. In the absence of clear standards, each hardware vendor continues to embed proprietary hooks in its version of UNIX, thus providing a lock to that vendor. Those hooks can be released with the assistance of skilled UNIX system programmers. Unfortunately, around 35-40% of UNIX software is now sold as part of a turnkey system, that is, by a single vendor responsible for integrating

© 1989 by INPUT. Reproduction Prohibited.

EXHIBIT VII-5

Vendor Opportunities in UNIX

- Office systems (file server)
  - EIS
  - OA
  - Text processing
  - Electronic mail
- Business applications
  - Accounting
  - Human resources
  - Education and training
- Personal productivity software
  - Spreadsheet
  - Easy-to-use RDBMS
  - Integrated "office workstation" software (communications, WP, spreadsheet, calendar, telephone directory)

EXHIBIT VII-6

User Opportunities in UNIX

- Multi-user, multi-tasking applications
- Communications-intensive applications

© 1989 by INPUT. Reproduction Prohibited.

hardware, system software, and application software in addition to providing customer support, training and education, and service. Since more than 90% of turnkey systems are sold to unsophisticated users, it is not realistic to expect these same users to find outside UNIX expertise. In the short term, then, the user will remain locked into that vendor's products and services.

D

Recommendations to UNIX Software Vendors

Although the UNIX market is in a state of flux, a few recommendations can be made. Please refer to Exhibit VII-7.

EXHIBIT VII-7

Recommendations to Vendors

- Adopt any decent graphical user interface
- Develop more commercial UNIX applications
  - Spreadsheets
  - Accounting
  - Word processing
- Application software vendors, hedge your bets
- Out-Sun Sun Microsystems

First, UNIX vendors (and IBM) must adopt *any* decent graphical user interface (GUI) to stanch the flow of users to Apple. Pick one and designate it "the standard." Unfortunately, the following factors have had a greater influence on the selection of a GUI than the need for timely vendor response:

- UNIX and IBM politics
- Technology
- The growing number of software layers between the operating system and the end user

© 1989 by INPUT. Reproduction Prohibited.

Second, in order for UNIX to be truly successful, more commercial applications must be developed. Spreadsheets, data base management systems, accounting, word processing, and industry-specific applications with easy-to-use versions must be ported to AT&T UNIX.

Sun Microsystems' development agreement with Lotus (presumably for its 1-2-3 spreadsheet to be ported to Sun's semi-proprietary SunOS), a step in the right direction, does not go far enough. To position its products for truly open systems computing, Lotus must port to "vanilla" AT&T UNIX, rather than to proprietary versions.

On the other hand, in July 1989, Andersen Consulting introduced a UNIX-based shop floor manufacturing (cell control) package running on supermicrocomputers and minicomputers. The product, called Cell-Pac, likely represents Andersen Consulting's testing of the UNIX market and, if successful, would follow with products for manufacturing resource planning (MRP II) and factory management.

Third, for those application software vendors which have not decided on UNIX, hedge your bets. Support existing application software running under proprietary operating system(s). But carefully evaluate the opportunities in UNIX, including:

- Competing vendors of application software, which are adopting UNIX and serving national, regional and local markets
- Hardware vendors that are offering or planning to offer UNIX-based systems
- Activity in the UNIX-based RDBMS market
- UNIX-based LANs and peer-to-peer communication

The advice for vendors is: Move slowly toward UNIX, adopting those products closest to pure vanilla standards, in anticipation of a vendor shakeout or modification to so-called standards. What is most unusual is that not one hardware or application software vendor has adopted a modified version of Sun's strategy.

INPUT expects a vendor to assemble a system based on relatively pure UNIX standards (IEEE, Federal government's POSIX, and/or ANSI). Such an approach, making it easier to migrate to a relatively "pure" system than to move away from it, would enhance sales and further the overall standing of UNIX. In other words, out-Sun Sun Microsystems!

© 1989 by INPUT. Reproduction Prohibited.

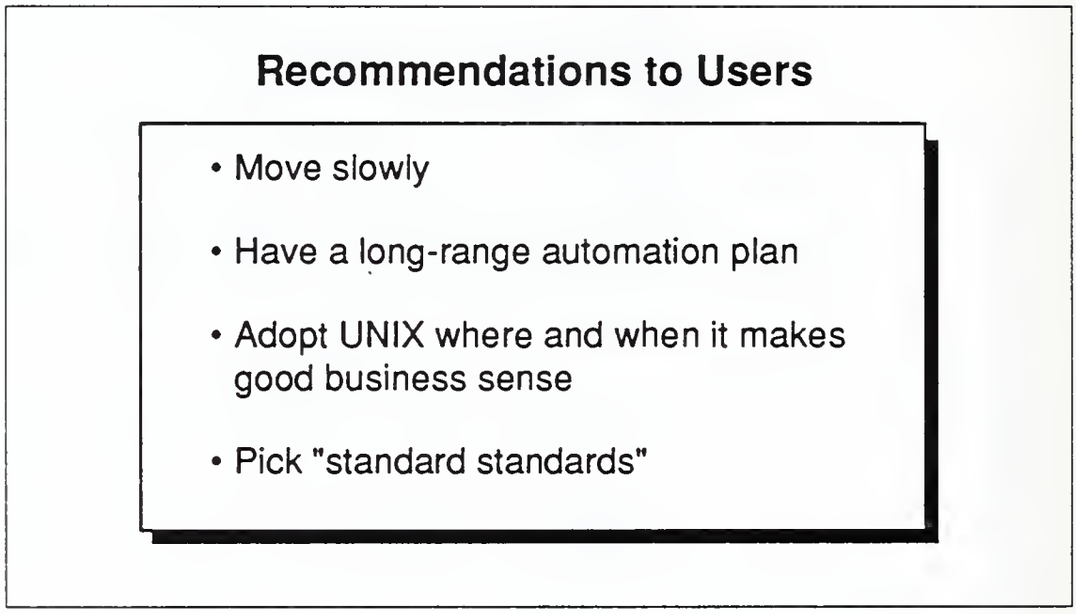
E

Recommendations to UNIX Users

Exhibit VII-8 summarizes INPUT's recommendations to users.

In this important area, users are clearly in control. UNIX began in a lab in the late 1960s, moved into technical applications in the early 1980s, and is only now becoming more widely accepted. Users adopted UNIX as it has evolved. If everyone adopted UNIX in 1983 (as one market research firm—not INPUT!—widely predicted), then the low-quality product at that time would have turned off numerous future commercial users. Moving slowly, especially with the confusion in the UNIX market today, makes sense.

EXHIBIT VII-8


Recommendations to Users
• Move slowly
• Have a long-range automation plan
• Adopt UNIX where and when it makes good business sense
• Pick "standard standards"

Second, have a long-range automation plan for your company. Investigate the pros and cons of UNIX; compare this objectively with other operating environments; then decide which way to go. Do not adopt UNIX or, for that matter, SAA (IBM), EMA (Digital Equipment), DAA (Data General), HPPA (HP Precision Architecture), or any other architecture without having a road map to follow. Obtain sufficient information from the vendor to determine the degree to which the direction of its products matches your company's automation road map.

Third, adopt UNIX where and when it makes solid business sense to do so. UNIX works well in multi-user, multi-tasking applications and/or those applications requiring extensive communications. Do not adopt UNIX for applications where current versions are weak—file security, record locking, input/output-intensive operations, and user friendliness. In fairness to UNIX developers, many weaknesses have been addressed, making it highly competitive in many applications.

© 1989 by INPUT. Reproduction Prohibited.

UNIX is not the universal answer. However, it offers a solid alternative to the world of proprietary systems and, importantly, it is a "real" product. Make sure you have the need for open systems, the resources to commit for IS staff training and education, and the resources and willingness to handle end user re-education.

© 1989 by INPUT. Reproduction Prohibited.

© 1989 by INPUT. Reproduction Prohibited.